McGraw-Hill Publishing Company, Inc.

October 25, 1928

OCT 27 1928

# Engineering News-Record

*Devoted to Civil Engineering and Contracting*

*Well drills at edge of Palisades starting cut for Hudson River Bridge approach*

# *Maintenance?* There is none on a Federal Roof!

WHAT WILL THE ROOF COST?
No. 4 of a Series
That Will Interest Everyone Connected with Building Projects
OTHER ROOFS
Replacements
Repairing
Painting
First Cost
The elements of cost are:
1. Cost of supporting steel
2. Cost of roof itself
3. Cost of composition covering (on flat decks only)
4. Cost of maintaining roof (flat or pitched)
5. Cost of interruptions to activities
FEDERAL
First Cost
Last Cost

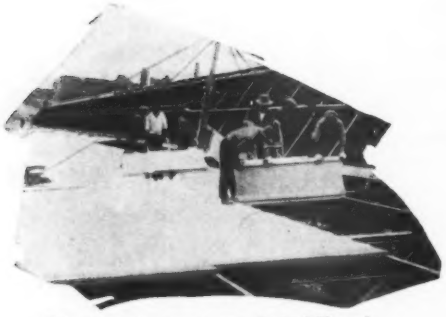
Of all parts of a building, the roof is certainly not one to "buy for the present and let the future take care of itself!"

No part of the building has to stand the punishment that a roof does. It is not surprising, therefore, that buyers *expect* to spend money on painting, repairing, and eventually replacing the ordinary roof. Maintenance on common roof materials cannot be ignored—it must come and must be paid for.

But why spend this money uselessly? A Federal Roof is paid for but once. It is concrete, immune to every effect of time and weather, to smoke, steam or gases—to fire. There are no costly interruptions to production or loss of business. All maintenance expense is automatically eliminated—a saving more than sufficient to roof another building!

***Our engineers have these and other facts for your analysis. Ask for details—no obligation whatever.***

*Made, Laid and Guaranteed by*
FEDERAL CEMENT TILE CO.
608 S. Dearborn Street · Chicago
FOR OVER A QUARTER CENTURY



*Wolverine Tube Co., Detroit. Federal Channel Slabs form a permanent, fireproof, roofdeck for flat or sloping surfaces, to take the usual composition covering.*

*No Building Can Be Firesafe Without a Fireproof Roof*

*Commonwealth Steel Foundry, Granite City, Ill., covered with Federal Red Interlocking Tile, which saves cost of composition covering. Note: Though walls are steel sheets, roof is permanent.*

# FEDERAL CEMENT TILE

New York, October 25, 1928

# Engineering News-Record

*A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor*

F. E. SCHMITT, *Editor*

*Editorial Staff*
*New York*
M. N. BAKER
C. S. HILL
W. G. BOWMAN
H. W. RICHARDSON
V. T. BOUGHTON, *Managing Editor*

WILLARD CHEVALIER
*General Manager*
*Editorial Staff*
*Chicago*
E. E. R. TRATMAN
W. W. DE BERARD
*San Francisco*
N. A. BOWERS

# Contents

*Volume 101, Number 17, October 25, 1928*

**Mining the Palisades for Bridge Anchorages** . . . . . 610
DESCRIPTION of the work to be done on the New Jersey end of the Hudson River suspension bridge.

**Pennsylvania R.R. Relocation Avoids Suburban Towns** . . . . . 614
ECONOMIC and practical problems encountered in improving main line from Pittsburgh to the west.

**Upper Tame Regional Trunk Sewer Project in England** . . . . . 615
JOINT OUTFALL SEWER under consideration to do away with local pumping stations and sewage-works.

**Highway Bridge Maintenance in Allegheny County** . . . . . 616
ORGANIZATION described that inspects and keeps in repair 376 bridges—Design lessons outlined. By R. H. Helick

**Elements of Good Practice in High Dams** . . . . . 622
SUMMARIZED RESULTS of experience in dam construction presented to Am.Soc.C.E. by A. J. Wiley and D. C. Henny.

**Drainage by Pumping on Salt River Project in Arizona** . . . . . 624
GROUNDWATER table kept down by 160 pumps that raise 300,000-acre-feet yearly. By T. A. Hayden

**Large Tank Equalizes Water Pressure at Springfield, Ill.** . . . . . 625
SERIOUS DROPS in pressure overcome by installation of 1-m.g. elevated storage tank.

**Engineering Side of Public Health Discussed at Chicago** . . . . . 626
FINANCING, control of odors and tastes and research in disposal of wastes dealt with.

**Repairing a Truss Bridge Under Traffic by Arc Welding** . . . . . 628
BOUND BROOK (N. J.) structure receives new floor beam flanges and new bottom chord and web members. By L. B. Woodruff

**Editorial** . . . . . 607

**Letters to the Editor** . . . . . 631

**News of the Week** . . . . . 634

**Construction and Equipment Materials** . . . . . 640

**Business Side of Construction** . . . . . 642

**McGRAW-HILL PUBLISHING COMPANY, INC., TENTH AVENUE AT 36TH STREET, NEW YORK, N. Y.**

NEW YORK District Office, 285 Madison Avenue
WASHINGTON, National Press Building
CHICAGO, 7 South Dearborn Street
PHILADELPHIA, 1600 Arch Street
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie Street, London, E. C. 4

JAMES H. McGRAW, President
JAMES H. McGRAW, JR., Vice-President and Treasurer
MALCOLM MUIR, Vice-President
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
C. H. THOMPSON, Secretary

Publishers of
American Machinist — Engineering News-Record
Power — Chemical and Metallurgical Engineering
Coal Age — Food Industries — Radio Retailing
Engineering and Mining Journal
Ingeniería Internacional — Electric Railway Journal
Bus Transportation — Electrical Merchandising
Electrical World — Construction Methods
Electrical West
(*Published in San Francisco*)
American Machinist—European Edition
(*Published in London*)

SUBSCRIPTION PRICES: United States and its possessions, Canada, Mexico, and other countries taking domestic postage rates, $5 a year. All other foreign countries, $9 a year. Single copy, 25 cents. Published weekly. Entered as second class matter, April 11, 1917, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

Copyright, 1928, by
McGraw-Hill Publishing Company, Inc.

CHANGE OF ADDRESS
Subscribers are requested to send both the old address and the new address when they move to a new address.
Member—Audit Bureau of Circulations.
Member—Associated Business Papers.

**Construction Market Place, 152** **Searchlight Section, 125** **Index to Advertisers, 160** **Directory of Consulting Engineers, 121**

**Number of Copies Printed This Issue, 31,919**

# JUST PLAIN LOVE OF THE GAME

TWENTY-FIVE THOUSAND STONE & WEBSTER MEN KNOW THAT THE GROWTH OF A PUBLIC UTILITY COMPANY DEPENDS ON ITS SUCCESS IN SERVING THE PUBLIC.

"THE storm broke early in the day, and by night our lines were in a state of chaos. I sat in the distribution office all through that night and watched the battle fought out. What kept those linemen on the job without food or sleep? It wasn't wages—you can't pay men for such losses—it was just plain love of the game—just fighting spirit—Stone & Webster Spirit—that kept them at it. They sensed the romance in it. Why, they stormed in there, beaten from the towers by a 75 mile gale of sleet, soaking wet or frozen stiff, grousing like soldiers in a front-line trench, damning the cars, the tools, the wind, damning everything, till the cars were replenished with gas and oil and they were off again. There was trouble to spare that night—everyone knew where to find it, and went out to get their share. Swearing? Sure—Mad? Clean through—who but a moron or fool giggles at a blizzard—but happy? Every last one of them, and fighting with all they had."

*—A Manager's Report*

Stone & Webster men are recognized for the part they play not only on the job but in the community. Wherever there is a Stone & Webster company, there you'll find a group of men, bound together by a common fellowship, taking an active part in local affairs; working for civic betterment, helping to develop local industries. The Stone & Webster training fits its men for public service.

## STONE & WEBSTER

INCORPORATED

OPERATE FINANCE BUILD

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
EDWARD J. MEHREN, *Vice-President*

WILLARD CHEVALIER
*General Manager*
F. E. SCHMITT
*Editor*

Volume 101 NEW YORK, OCTOBER 25, 1928 Number 17

## *The Nation Joins*

SELDOM has the presentation of a Congressional medal more truly expressed the symbolism of that act than did the ceremony of last Saturday, when such a medal was presented to Thomas A. Edison "as a token of the high esteem and grateful appreciation of your country." Behind the Secretary of the Treasury as he made the presentation stood the whole nation in whose name Congress had authorized the medal to be struck off. The deeds of other men similarly honored, or the special services which they have rendered to their country, have touched directly but a relatively small number of our citizens. But who is there who has not benefited by what Edison did in his laboratory throughout the years? His greatest contribution, the development of the electric light, suffices to engrave his name on the lasting roll of great benefactors of the human race. The whole nation joins President Coolidge in saying, "Noble, kindly servant of the United States and benefactor of mankind, may you long be spared to continue your work and to inspire those who will carry forward your torch!"

## *Professional Responsibility*

THE conviction of a municipal engineer in Queens Borough, New York, of conspiracy to defraud the city of several millions of dollars in the drawing of specifications and the letting of contracts for sewers is not pleasant for engineers to reflect upon. Integrity and fidelity to trust are foundation stones of the civil engineering profession, and betrayal of trust is its greatest disgrace. It is some comfort to realize that only very rarely has an engineer in public service been false to to professional and personal principle—a record the more distinguished because the municipal engineer is almost constantly beset by political demands and pressure, often on the part of men who hold his destiny in their hands. In the Queens case it was charged that the specifications had been framed so that a specific type of pipe had to be used, but this rather legalistic element of the case is minor compared to the fact that the engineer countenanced the award of contracts at two or three times a fair price. This direct violation of his public trust involved a shameless waste of the taxpayers' money and represented a wanton disregard of his professional responsibility. It reflects on municipal engineers everywhere and no less so because their aggregate record in matters of professional ethics is so high. And it challenges their support of efforts to rid public service of similar corruption.

## *Superscientized Design?*

MUCH attention has been given of late to concrete dams of novel design, dams which can be built for a lower unit cost, dams which require less material and dams of greater height than any heretofore built. This has not been mere speculative thinking, for numerous projects are under way or definitely projected along these lines. For example, a multiple-dome dam is nearing completion in Arizona, a constant-angle arch, 400 ft. high, is being built in Washington, and in southern California bids are now being received on a gravity dam to be about 450 ft. high, estimated to cost $25,000,000. All of this is indicative, no doubt, of advanced thinking on the theory of concrete dam design—an altogether desirable condition so far as progress toward larger structures and improved types is concerned. Meanwhile, the design of gravity or simple arch dams of ordinary height has received something less than its due share of attention, and to maintain a reasonable balance and a healthy condition in the art it is time that more attention should be focused on these common types. Otherwise, modern practice in dam design is in danger of becoming "superscientized"—a top-heavy condition in which fundamentals have not been adequately developed and standardized.

## *Senseless Bluffing*

IT IS stated frequently that cut-throat railroad construction is a thing of the past. That it is not, that it is suppressed rather than dead, is indicated by an incident which occurred during a hearing before the Colorado Public Utilities Commission in Denver recently. The commission, sitting in the dual capacity of a state commission and representative of the Interstate Commerce Commission, was hearing arguments as to the construction of the Dotsero cutoff, a proposed line to give the Moffat tunnel route an outlet to the west by a connection between the Denver & Salt Lake Railway and the Denver & Rio Grande Western Railroad. The two roads are in sharp disagreement as to how the new line shall be built and operated. When it appeared that the hearing was not bringing them any nearer to agreement, William H. Williams, chairman of the board of the Denver & Rio Grande, made the spectacular announcement that his company was prepared to build its own line to Denver, including a tunnel paralleling the Moffat tunnel, if the Denver & Salt Lake would not meet its terms. This threat has an old familiar sound, but in modern days it is apt to be an empty one. The Interstate Commerce Commission, not the board of directors of the Denver & Rio Grande, has the final say as to whether such a line may be built. That sort of threat, so effective in the past in bringing the smaller railroad companies into line, serves now simply to justify the contention, opposed generally by the railroads of the country, that it is necessary for the Interstate Commerce Commission to continue its control over new railroad construction.

## *A Maintenance Lesson*

A UNIQUE problem in road-bridge maintenance exists in Allegheny County, which may be considered the metropolitan region of Pittsburgh. There are eighteen major county bridges and nearly 400 smaller bridges on the county highways. No county road department of which we know has such a number of bridges, and particularly such a number of great river bridges, to be kept sound structurally and in a condition best to serve traffic. This

necessity has been met by the creation of a county bridge maintenance organization which in the quality of its engineering direction is equaled only by the bridge maintenance organizations of great railway systems or of a few cities like New York and Chicago. The work of this county bridge maintenance organization is succinctly outlined in this issue. The character and substance of the information given is called to attention. It is a summation of the teachings of experience (1) in the technique of making bridge repairs and (2) in the design and construction of bridges to reduce upkeep and to make easier the maintenance work that has to be performed. Such information is being too seldom made available by maintenance engineers, whether in the matter of bridge upkeep or in that of keeping ordinary roadbed and pavement in repair. Designing and constructing engineers put their experience on record far oftener, yet the maintenance engineer has great opportunity to advance design and construction. In Allegheny County the constructing engineers admit that they are being helped in both tasks by what the maintenance engineer is able to tell them. There is a lesson to public road officials in the experience of Allegheny County.

## *Aerial Common Carriers*

THE Railroad Commission of California is preparing proposed legislation relative to the regulatory control of aerial carriers. Three committees are working on as many subdivisions of the subject, formulating rules that will soon be needed. This is wholly logical and natural, both as to the state that is taking the initiative and as to the method of procedure that is being followed. California is the logical place of origin for this move, because that state has outstripped all others in its advance toward "air-mindedness." Department of Commerce reports in August listed 639 aircraft owned in California, while New York came next with only 387. The regulatory functions of utility commissions can readily be extended to cover aerial transport just as they were expanded a few years ago to include motor buses, a form of transportation not in general use when commission regulation came into vogue. Aerial transport promises to develop and extend far more rapidly than any previous form of transportation. The total number of airplanes in the United States a few years ago amounted to only 400 or 500. This is in sharp contrast with the situation now; reports from the Department of Commerce last month listed 4,314 licensed aircraft, with a "conservative estimate" of the present rate of production in the United States as 600 airplanes per month. The civil engineer fits into this picture in several ways, just now more particularly in the development of airports. Every progressive city of any size is building or planning for a suitable municipal airport. Nor is this limited to municipal ventures, for many private fields will certainly be built, as witness the company recently organized in California to build a chain of private airports at 50-mile intervals along the Pacific Coast from the Mexican border to the Canadian line and another company organized in New York not only to build private airports from coast to coast but to establish pilot schools in connection with each of them. But the civil engineer must not concern himself merely with the physical requirements of air transport engineering. Its economic problems are his also. The regulatory control of aerial carriers is one of the first broad questions to which he should direct his thinking.

## *A Code of Dam-Building Practice*

A VISITING engineer from a foreign country who asked for some concise compilation of our modern practice in the design of concrete dams would get no satisfactory reply. We have nothing of the kind to offer. If the foreign visitor knew our situation well enough he might say, "In characteristic American fashion, you have made unprecedented progress in the matter of advanced specialized design of dams, but you have not yet completed the development of standard practice," and this criticism would be true.

Moreover, our designers are not even in agreement on some of the important fundamentals of standard practice. For example, of late there have been sharp clashes of technical opinion over the curving of gravity-section dams, and where arch action cannot be developed it is now an open question as to whether the advantages of curving the dam offset the disadvantages. There is also more or less difference of opinion about the extent to which allowance should be made for uplift; about provision for seepage; about contraction joints and other matters, each an important element in design. The difficulty is not in lack of experience but rather in there being no systematic means whereby experience may be interpreted, recorded and applied. The extent to which authoritative opinions differ was evident in the papers and discussion at the recent meeting of the American Society of Civil Engineers at San Diego.

A real service to the profession could be rendered by a committee that would compile a concise classification of accepted practice affecting the fundamentals of dam design. In its final stages, at least, this work, which would amount to the compilation of a code, should be under the ægis of a national organization, preferably the American Society of Civil Engineers, and the recommendations should be made truly national in character and scope. Practical difficulties make it doubtful whether this objective could be best accomplished by starting with a representative national committee. Being widely scattered as members of such a committee naturally would be, the work would have to be done by correspondence, with only infrequent meetings at best. Progress would be slow and it might be difficult to reach agreement on points involving wide differences of opinion. This objection might be avoided by having local subcommittees, which could hold frequent group meetings, to work out details in certain assigned parts of the code; all such details to be reviewed, when the code was finally assembled, by a national committee.

The San Francisco Section of the American Society of Civil Engineers has recently had before it the suggestion that a compilation tantamount to a code be undertaken in California. No part of the country has wider interests or greater experience in dams, and the work of compiling a code can be done there at least as well as anywhere else. In the final stages of the work, however, there would be great advantage in having its development headed up in and approved by the American Society of Civil Engineers.

A danger in committee work, particularly menacing in this case, is the possibility that prejudice may creep in. A code to carry authority and exert constructive influence must be free from any opinion that is not well founded on logic or experience. Behind each major point in recommendations written into a code there must be a background of supporting facts and logical deductions. Obvi-

ously, too, in the present case the line must be drawn sharply between adequate scope and excessive detail. But with proper care even a local committee can safeguard its work in these matters.

Any adequate code of dam construction would have to enumerate the factors that must be considered in building a safe concrete dam and state the best practice or the safe limits of design in essential particulars. Such points as reasonable limits for the ratio of base width to height under stated conditions; the necessity or otherwise for deep cutoff walls or adequate grouting; excess spillway capacity; provision for drainage and for inspection; contraction joints; permissible unit stresses in plain and reinforced concrete; and maximum allowable unit pressure on foundation rock of various grades, require exhaustive, specific treatment.

Work of this kind is not without its formidable difficulties. Much labor is involved, moreover. It would, therefore, be too much to expect a first draft of the code to be complete. At later dates it could be revised and expanded. Even in its ultimate form the code would not be expected, of course, to contain data from which a design suitable for any particular site could be developed. In this respect its function would be much the same as that of a building code.

Years ago, when a dam 100 ft. high ranked as a high dam, no code was needed. Now a very different situation obtains; dams are being built that involve very high pressures, an increasing number of lives are dependent upon their stability, and new state legislation is in prospect to prescribe the conditions under which dams may be constructed. Under these conditions credit would be reflected upon the profession by a capable committee organized to serve as a clearing house for experience in the design and construction of dams and to make a compilation of recognized standards covering safe dam construction.

## *British Regional Engineering*

REGIONAL engineering has long been practiced in England but until recently under some other name. Without pretense of taking the earliest examples, the most notable regional project appears to have been the London main drainage works, carried out by the Metropolitan Board of Works long before the creation of the Administrative County of London. A much later example is the London Metropolitan Water District. A second notable example in the sewerage field is the Birmingham, Tame and Rea Drainage District, created some decades ago to build trunk sewers and sewage-works for Birmingham and surrounding territory. This district was not as extensive as it might well have been. The recent growth farther up the Tame Valley has brought about a project designed to do away with pollution in the Upper Tame and also to get rid of numerous local sewage-works and sewage-pumping stations as described elsewhere in this issue. Although apparently otherwise initiated, the project seems to have been at least stimulated and has been approved by what is in effect one of the numerous regional organizations that have sprung up in England and Wales in the past few years.

The causes that have led to this Upper Tame regional sewer project are much the same as those that are leading to attempts to solve regional engineering problems in this country. Primarily they arise from rapid urban growth beyond a more or less dominating central city, in this case Birmingham. Territory once rural becomes a succession of cities and villages, some with and some without sewerage facilities. Where sewers and sewage-works exist they become inadequate with the rapid increase in population. Joint action becomes necessary. In the case of the Upper Tame region, various local conditions dictate provision of a trunk outfall to the existing sewage-works of the earlier and larger regional district.

With variations, this same process is going on throughout England and the United States and doubtless in other countries whose urban areas are not merely increasing in population but expanding their borders until they meet. It is bound to continue. It has created demands not only for sewerage and water-supply facilities but also for many other kinds of municipal service, which can be met and must be met by regional engineering.

## *Earthquakes and Hurricanes*

PERIODICALLY some scientist announces that he has discovered a means for predicting the time of occurrence of an earthquake. The most recent theory, according to news reports, emanates from an astronomer at the Carnegie Institute of Technology, who, however, like his predecessors in earthquake prediction, fails to state what hope his interesting discovery holds for the world at large. It is reasonable to assume that one of the most important results which he and his colleagues envision would be a general improvement in our engineering structures, particularly buildings, which would fit them adequately to withstand earthquake forces. Yet it is quite possible—one can almost say inevitable—that knowledge that an earthquake certainly would occur tomorrow or next Christmas would be of no structural benefit at all. Our buildings would not be ready for it. Proof of this contention may be derived from last month's West Indian hurricane. Every place it struck after it left Porto Rico had at least 24 hours' warning. Yet the structural damage in our own Florida was unusually severe. Human nature has never accepted the truism that an ounce of prevention is worth a pound of cure—except immediately after the disaster. When the sun comes out poor buildings multiply as before. Therefore, to contend that we would do anything more about a promised earthquake than Florida with all its experience does about a definitely predictable hurricane is sheer nonsense. When visitations of hurricanes and earthquakes are to be expected is not nearly so important to the structural engineer as where these phenomena are likely to occur. Fortunately, he does know rather definitely that hurricanes occur in the Southeastern states and that California and the far Southwest can expect earth disturbances. Unfortunately, he does little, broadly speaking, to guard his structures against Nature's eccentricities. Florida still persists in its short-sighted policy of prescribing totally inadequate wind design loads of approximately 20 lb. per sq.ft., while California makes sporadic and, therefore, only partly successful attempts at introducing a universal use of earthquake-design principles.

The fault is partly the engineer's, partly his employer's and partly the insurance underwriters' who make shabby building easy. Probably until human nature changes we can expect more energy to be displayed in cleaning up after a disaster than in devising ways and means of preventing the damage.

# Mining the Palisades for Bridge Anchorages

## New Jersey End of Hudson River Suspension Bridge Cables to Be Buried 250 Ft. in Solid Rock—Sloping Tunnels Excavated From Drifts at Bottom—Deep Rock Cut to Carry Roadway From Bridge Through Cliff

THE steel grillage that will anchor the four 36-in. cables of the great Hudson River suspension bridge at the New Jersey end will be buried in two wedge-shaped concrete-filled tunnels blasted out of the solid basalt rock of the Palisades. Parallel to the centerline of the bridge on 106-ft. centers, the tunnels reach a depth of 250 ft. below the surface at the back or west end, sloping upward toward the bridge. All of the total volume of 19,000 cu.yd. of rock moved from the tunnels was taken out from the bottom of the slope and hoisted up a shaft to the surface. The upper ends of the tunnels terminate in huge anchorage pits dug below the bottom level of the deep approach cut carrying the roadway from the bridge through the rocky cliffs of the Palisades. In these anchorage pits the cables flare out into 61 strands gripping the maze of eye-bars and beams buried in the tunnels.

As suspension cable anchorages the tunnels are of unusual size—167 ft. long, 55x44 ft. at the back end and tapering to 33x18 ft. at the outlet at the pits, with an arched roof of radius varying from 25 to 30 ft. throughout. A plan and sections of the anchorages are shown in Fig. 1. The methods used in excavating more than 200,000 cu.yd. of extremely hard basalt rock in the tunnels and cut are most interesting to the civil engineer and are described herewith.

*Tunnel Excavation* — The large size and peculiar sloping position of the tunnels called for extraordinary methods in underground excavation. To work the tunnels from the outlets would have necessitated waiting until the completion of the overlying approach cut and anchorage pits, which work was carried on simultaneously with that of the tunnels. In wiew of these conditions and to take advantage of gravity loading of the muck, the tunnels were attacked from the lower back side from a cross-drift 250 ft. long connected with a shaft 250 ft. deep. The shaft, 7x9 ft., was sunk entirely through rock near the northwest corner of the north anchorage clear of all underground and surface excavation limits. From the shaft bottom the cross-drift, 8x12 ft., was cut to the south skirting the back lower edges of the tunnels. Fig. 3 shows a diagram of the shaft and cross-drift in relation to the tunnels. Entrance to each tunnel area was gained through three small drifts cut through the east wall of the main cross-drift. As the excavated area enlarged, loading chutes and gates for controlling the loose muck were placed in these small drifts. Fig. 6 shows a muck car being loaded from chutes. Original plans for the order of procedure were to excavate a shallow bottom bench the full width of the tunnels from the back end to the outlet and then enlarge the area to full size by stoping overhead. But this method soon proved impracticable because the steeply sloping floor offered poor foothold from which to work. Plans were then changed to work a heading and bench system.

Work was carried on simultaneously in both tunnels. By the use of stoping drills the full section was cut out overhead from the bottom benches started at first, including the areas overlying the cross-drift. To provide working footing the loose muck was allowed to pile up in front of the headings, and as the outlet below was controlled by gates, the pile could be varied or maintained at any desired level. From 2,000 to 4,000 cu.yd. of loose rock was kept in storage in each tunnel for this purpose. When a full face heading was reached, work proceeded from a full crown drift through to the pits.

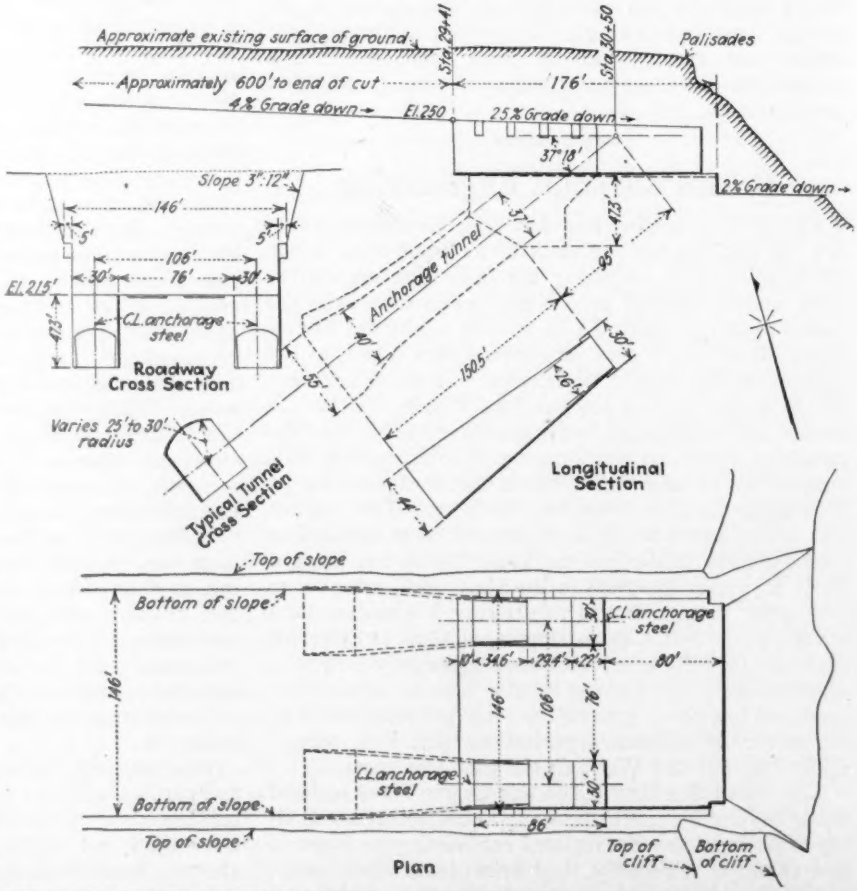



FIG. 1—PLAN AND SECTIONS OF NEW JERSEY ANCHORAGE, HUDSON RIVER BRIDGE

The remaining bench was then shot down by face and top drilling. Fig. 4 shows a diagram of the progress made and the relation of the muck storage and headings at various times. Drifter drills mounted on posts were used at the headings, while stoping drills trimmed the overhead rock. Drill steel up to 20 ft. long was used, varying in lengths in 2 ft. differentials, starting at 2 ft. No set schedule of drill holes or shooting was attempted. Shots contained from 80 to 100 holes depending on the shape, size and position of that part of the heading to be blasted. About 15 ft. advance was made with each shot.

To permit access to the working chambers through the loose muck two vertical timber manways or shafts were built up in each tunnel. These manways contained ladders, air and water pipes, ventilating pipes and a hoistway for drill steel, dynamite and other supplies. Walkways suspended from cables led from the tops of the manways to the headings. Temporary scaffolds swung from cables afforded access to the high spots that could not be reached from the muck piles. All cables were fastened to heavy split-end eye-bolts wedged into drill holes.

Lines and grade elevations were carried down the main shaft, across the drift and up the manways into the tunnel areas. When both tunnels had been holed through into the anchorage pits, the instrument work checked out within less than 0.02 ft.

Ventilation was supplied by a blower on top with a 14-in. spiral riveted pipe leading to the workings. Further ventilation was obtained through an 8-in. well-drill hole drilled into the center of each working chamber after the excavation had progressed past the center point. These holes also provided an opening through which dynamite and drill steel were lowered into the tunnels in long well buckets handled from the surface by tugger air hoists. Previous to using the well holes all supplies were necessarily routed down the main shaft, then to and

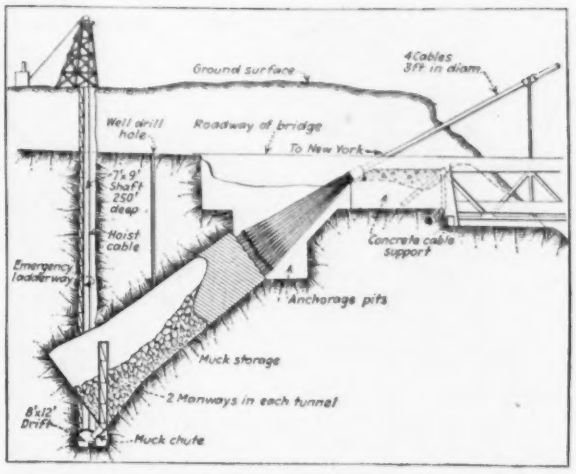



FIG. 3—DIAGRAM SHOWING RELATION OF SHAFT AND CROSS-DRIFT TO ANCHORAGE TUNNELS

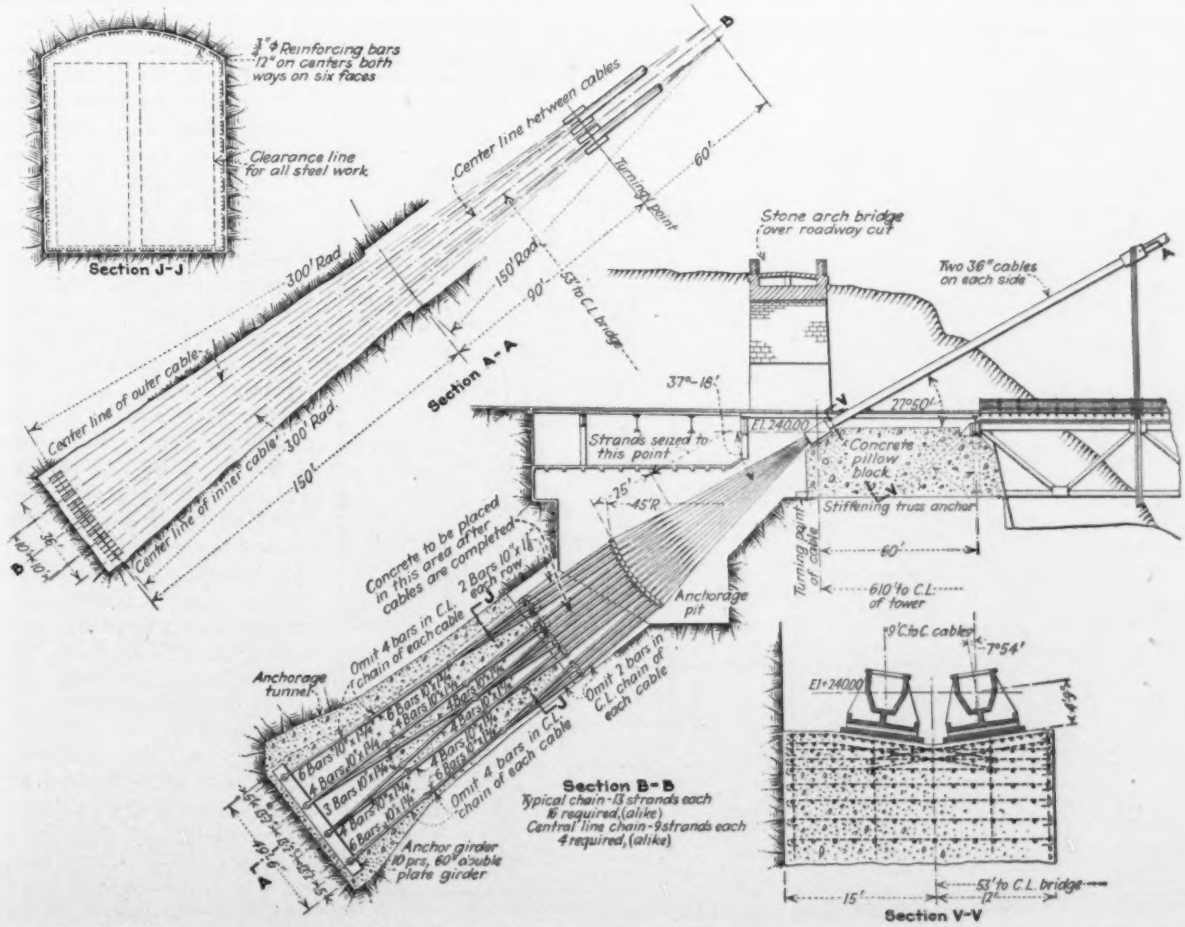

¾" ϕ Reinforcing bars 12" on centers both ways on six faces
Clearance line for all steel work
Section J-J
Center line between cables
Turning Point
60'
300' Rad.
150' Rad.
90°
53' to C.L. bridge
Section A-A
Stone arch bridge over roadway cut
Two 36" cables on each side
37°-18'
27°50'
El. 240.00
Strands seized to this point
Concrete pillow block
Stiffening truss anchor
25'
45' R
Turning point of cable
610' to C.L. of tower
Center line of outer cable
Center line of inner cable
150'
Concrete to be placed in this area after cables are completed
2 Bars 10"x1⅛" each row
Omit 4 bars in C.L. chain of each cable
Anchorage pit
Anchorage tunnel
Omit 2 bars in C.L. chain of each cable
Omit 4 bars in C.L. chain of each cable
Section B-B
Typical chain-13 strands each 16 required, (alike)
Central line chain-9 strands each 4 required, (alike)
Anchor girder 10 prs, 60" double plate girder
9' C. to C. cables
7°54'
El. 240.00
15'
53' to C.L. bridge
Section V-V

FIG. 2—DETAILS OF ANCHORAGE TUNNELS AND PITS, SHOWING GRILLAGE STEEL AND CABLE CONNECTIONS

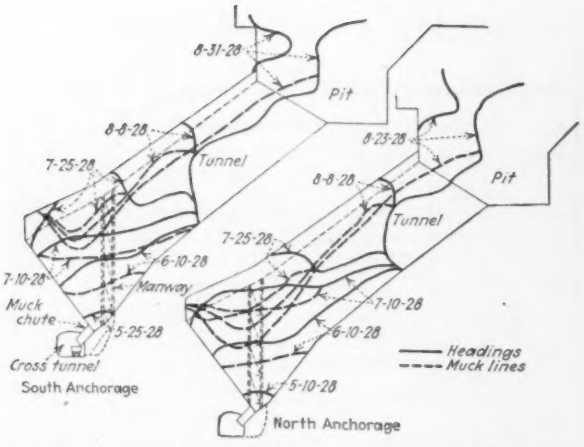



FIG. 4—PROGRESS DIAGRAM OF TUNNEL EXCAVATION
Relation of muck storage piles to headings shown for various dates. Change from bottom bench as started to top bench used when holing through into pits can be followed.

up the manways and across to the headings by hand-operated cableways. Handling the long drill steel was thus changed from a formerly difficult procedure to a comparatively simple operation.

Hinged and sliding gates having proved unsatisfactory, loose boards placed over the upper ends of three 36-in. chutes at the lower outlets of each tunnel controlled the muck loading. The boards were pried apart and back into position by bars. Naturally with the great weight of loose material in storage the muck often arched across the narrow openings, requiring light blasting to loosen up the packed masses.

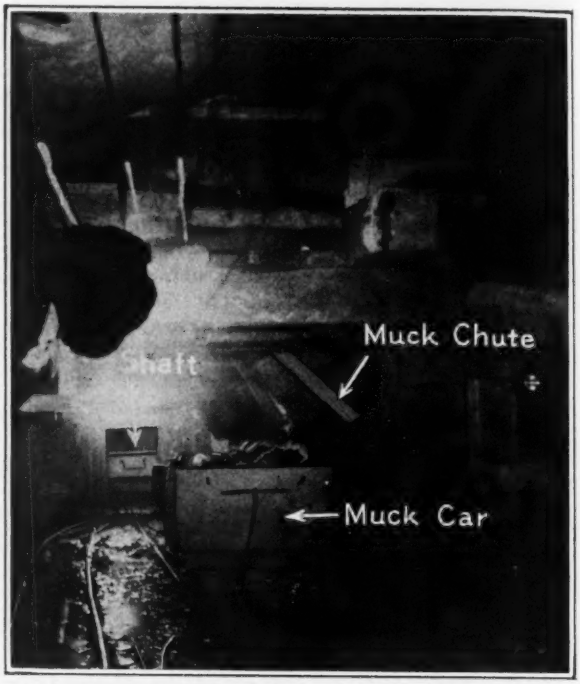



FIG 6—INTERIOR OF CROSS-DRIFT SHOWING CAR BEING LOADED FROM NORTH ANCHORAGE MUCK CHUTES

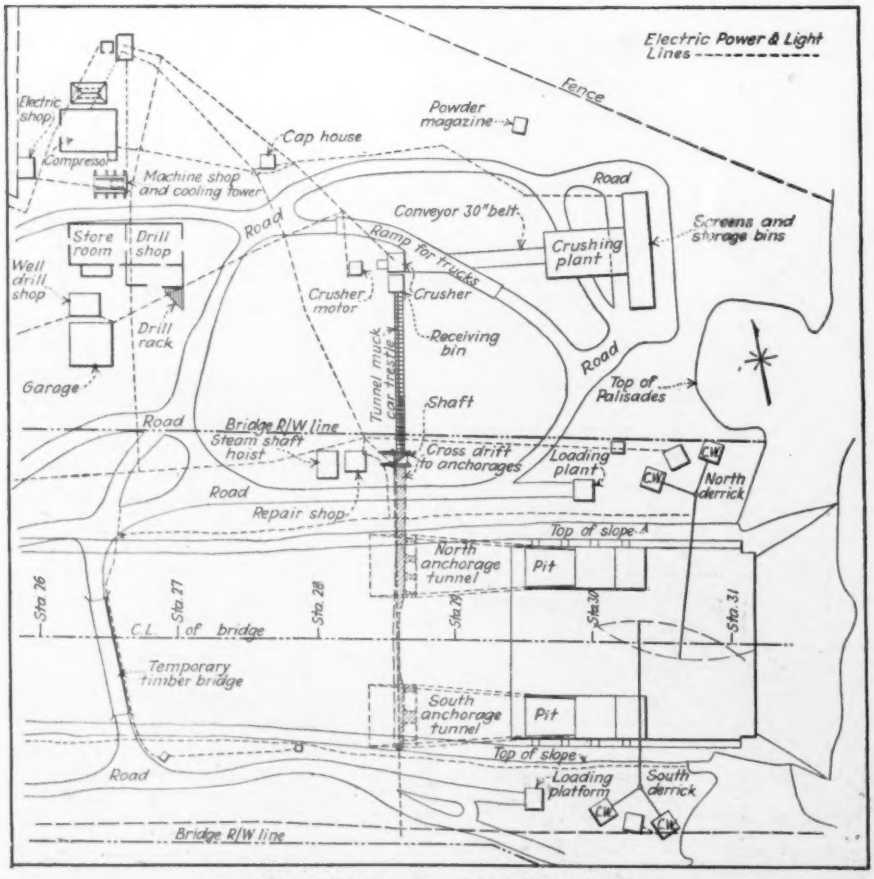



FIG 5—CONTRACTORS' PLANT LAYOUT
Location of shaft and cross-drift clearly shown. All excavated material passes through crushing plant.

After the muck cars were loaded from the chutes, they were pushed by hand to the shaft, hoisted on a skip to a trestle 45 ft. above the surface, and then run out 150 ft. to a dumping bin. From this bin the muck passed through a 40x48-in. primary jaw crusher, electrically operated, and was then carried by a 30-in. conveyor belt to a crushing plant for further reduction and screening.

Using a crew of 30 men for each of three shifts, an average of 200 cu.yd. of rock per day was moved. Each shift consisted of the following crew besides the general foreman: One hoisting engineer, two trammers on top, one top man, one signal man, three trammers below, two drill foremen, fifteen drillers and blasters, and five muckers and helpers.

*Tunnel Excavation Plant*—Drilling into the extremely hard basalt rock required an unusual amount of steel sharpening, which was done in a well-equipped shop with electric pyrometer-controlled oil furnaces and air sharpeners. A feature of the shop was a hori-

zontal storage rack for sharp steel, built on stakes and containing separate racks for each size steel. The air guns were repaired in a special shop at the shaft opening. The complete tunnel and excavating plant layout is shown in Fig. 5.

A 10x12-in. steam hoist engine was used at the shaft, hoisting the loaded muck cars on a skip carrying a short section of track. The skip guides were two 4x6 in. vertical timbers fastened to horizontal frames which were spaced about 10 ft. apart and lagged into oak plugs driven into drill holes in the shaft sides. The compressor plant consisted of two two-stage electrically driven compressors of 800 cu.ft. capacity each at 100 lb. pressure. Outside the compressor house is an elevated cooling tank, under which is a machine shop capable of handling most of the job repair work.

Besides the primary jaw crusher at the dump bins, the crushing plant consists of two gyratory primary crushers, two gyratory reducing crushers and several screens. All except the jaw crusher are located in one crusher house fed by the conveyor belt. All the tunnel muck and rock excavation from the cut and pits is being crushed and sold. The hard basalt has a devastating effect upon the crusher machinery, requiring frequent renewals of the rollers and jaws.

*Roadway Cut and Anchorage Pits*—Excavating the roadway cut involves the moving of more than 180,000 cu.yd. of material, mostly rock, and the anchorage pits add 4,500 cu.yd. to this total. As seen from Fig. 1, the cut is about 800 ft. long, 146 ft. wide for most of its length, widening out to 176 ft. at the river end, and reaching a maximum depth of 80 ft. at the same end. Large-scale quarry operations are being used in ex-

FIG. 8—TWO WELL DRILLS IN ACTION IN DEEPENING ROADWAY CUT

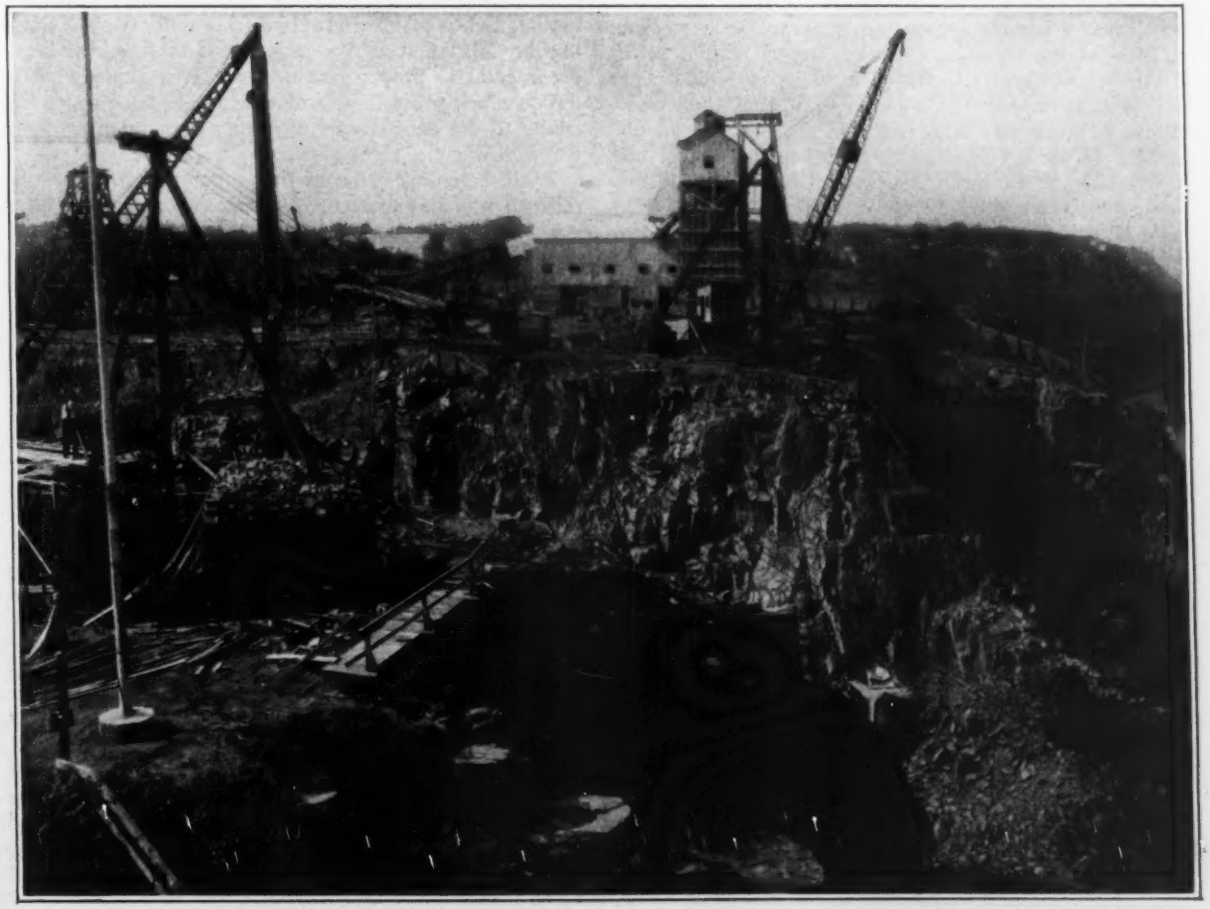


FIG. 7—VIEW OF ROADWAY CUT FROM SOUTH SIDE, SHOWING LOADING DERRICKS AND CRUSHING PLANT

FIG. 9—WEST END OF ROADWAY CUT
Cut as shown is only part of final width. Timber bridge used by trucks loaded by south derrick.

cavating the cut and pits, an average of 600 cu.yd. per day of three shifts being moved. Well-drill holes, 8 in. in diameter, are used in blasting, supplemented by smaller bores drilled with tripod air drills. Two of the well drills in action are seen in Fig. 8. A well-drill bit-sharpening shop is supplied with air sharpeners, an oil furnace and a hand-operated crane for handling the bits.

After stripping the shallow layer of earth off the roadway area, a narrow cut was dug along the centerline, starting at the west end, loading trucks with a heavy electric shovel and a gas shovel. This preliminary cut is now being widened and deepened to final dimensions. Pieces of rock too large for the shovels to load are broken up by a "skullcracker," a 1-ton cast-steel ball handled by a fast crawler gas crane.

As the river end of the cut opened up, the excavated material was hoisted to the original ground level by two heavy steel stiff-leg derricks, electrically operated, one on each side of the cut (Figs. 5 and 7). These derricks with their 120-ft. booms cover the entire east end of the roadway cut and the anchorage pits. Material is handled by the derricks in skips loaded by the shovels below and dumped into trucks through loading hoppers. The trucks all dump direct into the primary jaw crusher at the crushing plant. A temporary timber bridge carries the truck roadway from the south derrick over the cut to the crushing plant on the north side of the workings (Figs. 5 and 9).

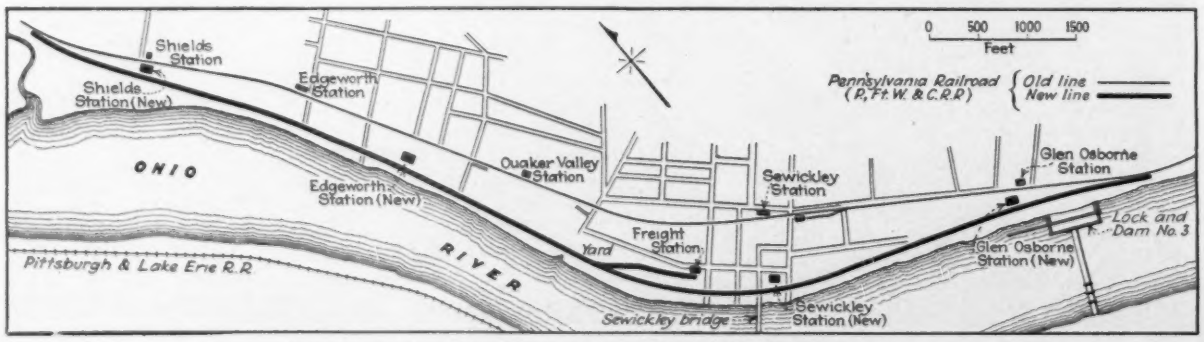
The excavation of the anchorage tunnels and pits and that part of the roadway east of station 29+41 (Fig. 1) was completed according to contract in 15½ months' time, which period ended Oct. 19, 1928. To keep the work going at top speed all crews work on a bonus award system. Daily drill depths and yardages moved by each crew are posted on a huge scoreboard, the bonus prizes being awarded on a weekly basis.

The work is being done under the direction of the Port of New York Authority. O. H. Ammann is chief engineer of bridges, Montgomery B. Case is engineer of construction, F. E. Cudworth is resident engineer and A. B. Lincoln is directing the work for the Port Authority. Foley Brothers, Inc., St. Paul and New York, has the contract for the work described here. The contractor's personnel on the job is: Carl L. Swenson, Eastern manager; J. R. Holmes, superintendent; J. T. Mayr, engineer; C. C. Freeman in charge of underground work, and Oscar Carlson in charge of the open-cut work.

## Pennsylvania Railroad Relocation Avoids Suburban Towns

BOTH economic and practical problems were encountered by the Pennsylvania Railroad in making a relocation at Sewickley, Pa., as part of the work of providing six tracks and otherwise improving its main line from Pittsburgh to the west. The old four-track line, passing through the town at street grade, had become objectionable on account of the numerous street crossings in a high-class residential suburb, 12½ miles west of Pittsburgh. Elevation of the tracks was undesirable as being detrimental to property values, while if combined with the six-track projects its cost would have been excessive, owing to the necessity of acquiring high-value property for widening the right-of-way.

With the co-operation of the municipal authorities the railroad was able to secure land at reasonable prices for a new 3½-mile, six-track right-of-way along the bank of the Ohio River, part of the line being a fill which extends to the harbor line established by the U. S. War Department. Only four tracks are laid at present. The new and the old locations are shown by the accompanying plan. As all the streets crossed are dedicated through to the river, they are spanned by bridges, although there is no outlet to land beyond the railroad. Some of these subways, however, may be utilized as passenger approaches to the new stations. Besides the main station at Sewickley there are three suburban stations. A freight house and a small local yard with stub tracks are also provided, as shown.




RELOCATION ELIMINATES TRACKS THROUGH SEWICKLEY, PA.

As the new line necessitated the destruction of two small water-works pumping stations, the railway company built new and larger plants for the municipalities. All outlet sewers were extended to the new waterfront. The railway has also filled to street grade the low ground on the land side of its new line, thus forming a site for real estate development. It has donated to the public the 3½-mile stretch of old four-track right-of-way, to be utilized as part of a boulevard which is being built from Pittsburgh to Rochester, Pa.

The railroad fill was made with slag from local steel works, delivered in trains of 60- and 70-ton hopper cars which were unloaded by a locomotive crane handling a clamshell bucket, except that the contents of the pockets were cleaned out through the drop doors. Cinders for a 24-in. bed of sub-ballast were delivered in the same way. The river slope of the fill was given a heavy revetment of basic slag from the steel works as a protection against erosion. Contracts for the excavation, grading and concrete work were let to W. F. Trimble & Sons, Pittsburgh, Pa., who used 4-yd. side-dump cars in making the fill on low ground from about 50,000 cu.yd. of excavation at the east end of the line. No construction trestles were used on this part of the work, the dump track being kept along the edge of the fill.

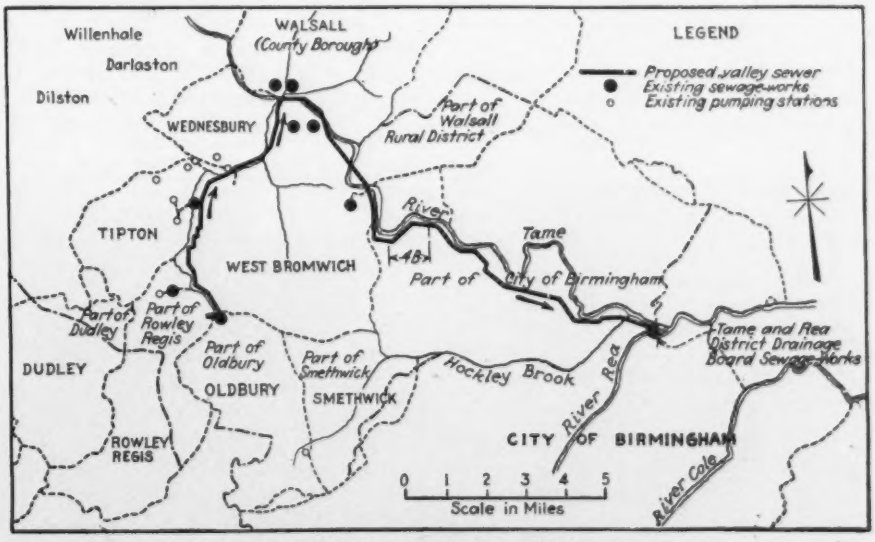
This improvement, not yet completed, is being carried out under W. D. Wiggins, chief engineer (central region), Pennsylvania Railroad, with H. W. Hinkley as resident engineer in charge.

## Upper Tame Regional Trunk Sewer Project in England

A JOINT outfall sewer to do away with local pumping stations and sewage-works is under consideration for the Upper Tame River basin, comprising a large area recently annexed to Birmingham and also nine separate governmental areas. The sewer would terminate at the existing sewage-works of the Birmingham, Tame and Rea Drainage District, where it is assumed that the sewage would be treated under an arrangement with the district. The sewer would be about 14 miles long and from 2½ to 9¼ ft. in diameter, with gradients from 1 to 70 at the upper to 1 in 1,000 at the lower end. It would be built of "best quality Staffordshire engineering bricks, with a pressed blue brick invert constructed on cement concrete cradling, and surrounded with cement concrete, the concrete work being reinforced with steel, where necessary, owing to risk of minor subsidences," according to an outline of the project in the London *Surveyor* for Aug. 10, 1928. For one stretch of the sewer, liable to land subsidence during mining operations, cast-iron pipe with special joints is proposed. The estimated cost of the sewers and tributary branches is £1,200,000, or about $5,850,000.

The foregoing figures are based on a report made by Herbert H. Humphries, city engineer and surveyor of Birmingham, apparently in his private capacity of consulting engineer. Mr. Humphries states in his report that at a meeting of municipal engineers in Birmingham in 1921 he pointed out the advantages to the communities in the Upper Tame River basin that would have resulted had this basin been included in the Birmingham, Tame and Rea Drainage District. Subsequently he was consulted by West Bromwich on the possibility of a joint outfall to serve it and the territory recently annexed partly to it and partly to Birmingham. Still later Aldbury asked to be taken into consideration. Finally the scheme was extended as already outlined. The enlarged project has been approved by the Midland Joint Town Planning Advisory Council and its Arterial Roads and Main Drainage Committee and has been given encouragement by the Birmingham, Tame and Rea district authorities.

The quantity of sewage to be transmitted is based on a dry-weather flow of 30 Imp. or 36 U. S. gal. per capita plus certain factory allowances. In accordance with British practice, however, the actual capacity provided for includes stormwater up to six times the dry-weather flow, with eight times in two sections of the region.




UPPER TAME OUTFALL SEWER PROJECT, ENGLAND

| Description | Areas, Acres |
|---|---|
| City of Birmingham (part of, including 3,085 acres within the recently annexed portion of the former urban district of Perry Barr) | 11,060 |
| County borough of West Bromwich (including the recently annexed portion of Perry Barr) | 6,506 |
| Rural district of Walsall (part of) | 1,820 |
| County borough of Walsall | 7,108 |
| Borough of Wednesbury | 2,287 |
| Urban district of Tipton | 2,161 |
| Urban district of Rowley Regis (part of) | 1,695 |
| Borough of Dudley (part of) | 629 |
| Urban district of Oldbury | 2,956 |
| County borough of Smethwick | 2,084 |
| Total | 38,306 |

## Indian Government Will Take Over the Burma Railways

It is reported by the vice-consul in Calcutta that the Indian government will take over the Burma railways as a state-managed concern beginning next year. These railways are state properties, but have for the last 32 years been operated by the Burma Railways Company. Burma now possesses 2,000 miles of open line.

# Highway Bridge Maintenance in Allegheny County

## Maintenance Organization Inspects and Keeps Up 376 Bridges—Repair Practices Described—Important Design Lessons Outlined

By R. H. Helick

*Maintenance Engineer, Bureau of Bridges, Allegheny County, Pittsburgh, Pa.*

Few County Highway Systems have as many bridges or bridges of such great size as that of Allegheny County, in which are located the city of Pittsburgh and its half-score of satellite industrial towns. There are 11¼ miles of bridges on the county roads, and 7.42 miles of this total is contributed by 28 bridges crossing the Ohio, Allegheny and Monongahela rivers. In consequence the county has a problem of major bridge maintenance and a separate problem of upkeep of scattered small bridges. The lessons of experience in this maintenance appeal to a wide audience. The highway bridge engineer has in the article which follows an argument for organization and ample mechanical equipment for maintenance and a description of numerous maintenance methods and procedures of practical application. This is the sort of information that maintenance engineers do not readily divulge and that the tyro in bridge upkeep seldom has a chance to get except, through the years, by personal experience. The article therefore commands attention. —Editor.

Allegheny County has a unique road-bridge problem. On the county highway system there are 376 bridges, not including stream crossings of the culvert class. Of these, 28 are large river bridges, aggregating 7.42 miles in length. The others are masonry and metal bridges over ravines and aggregate 3.83 miles in length. Under the plan developed since Jan. 1, 1924, all these bridges are maintained by the bureau of the county Department of Public Works, a self-contained engineering organization independent of outside help for design, construction or upkeep. Starting with design of structures in one division, another division of the bureau prosecutes construction and a third division takes the bridges over for operation and upkeep.

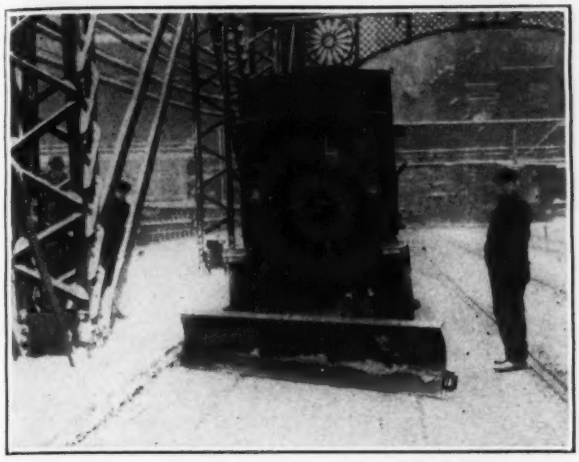
The bridge problem in Allegheny County, like its road problem considered in *Engineering News-Record* of Oct. 13, 1927, p. 580, is an outgrowth of geography and topography unusual in a large concentrated urban and suburban development. The three great rivers, the Allegheny, Monongahela and Ohio, divide the county, the city of Pittsburgh and its suburban territory into sectors. Along the banks of the main rivers there is some level land, but elsewhere throughout the county the topography is a jumble of steep hills and ravines with small streams leading to the rivers. The road system of the county consists of radial roads centering in Pittsburgh and connected by belt roads at different distances from the city center. The present 28 large bridges take these roads over the main rivers, and the remaining structures span the ravines and small drainage channels.

### Reorganization Plan

Previous to Jan. 1, 1924, there was no definite head of bridge maintenance activities; they were scattered among three organizations:

1. The county engineer's office had direct supervision of those bridges which in the past had been built by it. These bridges included three large crossings over rivers and a number of smaller ones over deep ravines, but most of them were small masonry or steel structures scattered throughout the county. These were taken care of at first mostly by contract, but later it was found that a permanent maintenance force was a practical necessity, and at the time of the formation of the Department of Public Works a small force of nine men was doing this work. Hired cars at a high rental were

STONE ARCH GUNITED TO CHECK DISINTEGRATION



SNOW PLOW USED ON LARGE BRIDGES

used to get to the work. The men had no headquarters and were poorly provided with tools and equipment.

2. Seventeen large river tollbridges had been acquired and freed by the county commissioners and had been turned over for maintenance to a bridge superintendent, who reported to the superintendent of buildings. The county engineer at that time was not directly under the jurisdiction of the Board of Commissioners but acted in a consulting capacity with respect to these bridges, making and supervising contracts and giving advice, all upon request. The bridge superintendent had a maintenance force consisting of bridge carpenters and a few steel workers. It was not well equipped and the headquarters were inadequate.

3. The bureau of roads had charge of a number of bridges built in connection with road contracts. Some of the steel structures were not getting adequate maintenance. The others were in the nature of culverts and are still being taken care of by the bureau of roads, their maintenance being best handled by the road-repair units.

*New Organization*—The Department of Public Works of Allegheny County, Pennsylvania, is an interesting example of what can be done to make an up-to-date organization out of an obsolete one. On Jan. 1, 1924, a new Board of County Commissioners, whose chairman was Joseph G. Armstrong, created a Department of Public Works. The department was organized by Norman F. Brown as director. Bridge and tunnel work was placed under the direction of a bureau of bridges, with V. R. Covell as its chief engineer.

At present all bridges which require engineering supervision are maintained under one compact organization. A maintenance engineer in constant touch with the superintendent of bridges reports to the chief engineer of the bureau of bridges. The maintenance engineer takes care of all technical questions that come up, gives advice on carrying out the work and supervises the purchasing of materials and the letting of repair contracts. The superintendent of bridges reports to the maintenance engineer. He has three assistants and a number of repair gangs and is responsible for the actual repair work. His force is made up from the old repair forces, which have been built up and specialized. He now has special men for carpenter work, cement work, metal work and painting.

*Mechanical Equipment*—Tools and equipment have been pooled and improved in quantity and quality. A portable circular saw has replaced the old hand crosscut saw; a portable gasoline-driven concrete mixer has replaced hand mixing; air compressors and pneumatic riveting guns have replaced hand riveting, and a cement gun is in regular use. One device that should be particularly mentioned is a snow plow which can be attached to the front of a truck when needed. This clears up bridge roadways in a remarkably short time. Formerly the snow stayed on the roadways until it could be shoveled off.

These tools, with three inspection cars and eight trucks and well-arranged headquarters, enable the repair forces to cover the county very efficiently. In fact, the labor-saving devices enable the same number of men to take care of the steadily increasing number of bridges, which are being used by more and heavier vehicles, making the maintenance problem more difficult and exacting each year.

### Design Lessons

Maintenance has thrown much light on design and type of structure. There is, first, the general lesson that masonry bridges are superior in economy to metal bridges in that they require a minimum of attention after construction. There is no steel to paint and usually the roadway is a continuation of that on each side of the bridge and can be maintained with it. If the bridge is built of materials that will weather well, the costs of maintenance are extremely low. This over a period of years compensates for the greater cost of masonry structures.

*Gunite Incasements*—Where steel construction is required, the steel should be incased with concrete or gunite wherever feasible where corrosion is likely to be great. Thus the side of girders facing the roadways should be covered, on account of the constant splashing from vehicles in wet weather. The bases of columns should be protected from splashing and from the constant tendency of the ground surface to be filled in and to rise around them. Bridges over railroad tracks are exceptionably vulnerable, and gunite incasement or gunite ceilings are particularly valuable at these points. The incasement is probably better, although heavier, since the ceilings leave all the steel between them and the bridge floor to be protected by paint.

CEMENT GUN OUTFIT GUNITING UNDERSIDE OF FLOOR

*Provision for Inspection*—The design of steel members and their connections should be such as to facilitate inspection and painting. Too often perfectly good designs fail in this provision, and then the maintenance man for years must contend with conditions that might have been prevented by a comparatively brief study of the design with this object in view. Ease of inspection is too often overlooked. It is hardly possible to provide inspection galleries under solid-floor bridges, yet this condition can be approximated in places, particularly around bearings on piers and abutments. When these bearings are roller bearings, such aids to inspection are vital. It should be easy for one man to reach these points safely so as to facilitate frequent and accurate observation of conditions.

*Oil-Filled Roller Bearings*—The design of roller bearings is important to the maintenance man. Many bearings have been found that were so damaged and clogged by dirt and rust that they no longer operated. The result is to place secondary stresses in members of trusses and even to split apart the piers. The practice in this bureau is to design the bearings like the pieces of fine machinery they are, and to inclose them in a bath of oil with provision for drawing off water at the bottom and placing new oil at the top. Where the motion of large rockers is great, a heavy oil pumps out of the boxes owing to its inability to flow fast enough around the ends of the rockers. This might be helped by perforations through the horizontal axis of the rockers, but the preferable way is to use a light oil which will flow readily.

In studying this condition it was discovered that, after excessive pumping out of the heavy oil, considerable water is found in the roller boxes. At first this was attributed to leakage along the tops of the boxes, where a slight gap must necessarily be left. Observation, however, showed no such leakage, and finally the engineers became convinced that the water was due to condensation from currents of warm moist air circulating in the roller boxes. The amount of water sometimes found is almost incredible. From a box $15\frac{1}{2}$x$4\frac{1}{2}$x$1\frac{3}{4}$ ft. nearly a barrel of water a year has been collected. When the boxes are kept filled with light oil there is very little space for the moist air to circulate and the amount of water found is negligible. The boxes are tapped at small vertical intervals to locate the water and let it out. Regular inspection is of course necessary.

*Handrail and Curb Requirements*—Handrail design and curb design are of importance. The former should be simple, strong and easy to repair and paint. A surprising number of automobiles seem to get across the sidewalks and into the railings. Proper curb design helps to prevent this, but it is amazing what some drivers can do seemingly without trying. Curbs should be high, but not high enough to strike running boards or mudguards. A very simple and effective design recently built consists of a concrete curb about 2 ft. high with two inclined surfaces toward the roadway, the lower one nearly vertical and the upper one more flatly sloped. Height is thus gained without anything but the tires coming into contact with the curb surface.

TEMPORARY REPAIR OF ABUTMENT WASHOUT

*Other Design Features*—Enough has been said to show what the maintenance man learns after the designer and constructor have finished their work. There are many other points that might be discussed, but they would take up too much space. Among them are traffic safeguards built into the structure, proper location of watchmen's shelters, comfort stations, self-cleansing gutters, expansion joints and waterproofing.

The design of floors constitutes a problem of great interest. Many bridges in Allegheny County were formerly paved with wood blocks, but these have very definite disadvantages when exposed to the weather, though they are very good indoors. Under the action of rain they are very slippery and unless provision is made for their expansion they will swell into waves and ruin the floor surface. Frost, too, will raise the floor surface if water gets under it. Brick, asphaltic concrete and portland cement concrete are all being tried in our new designs. They all have merits, but it is not within the province of this article to discuss them further.

STEEL TRAFFIC PLATES ON WOOD FLOOR BRIDGE

## Steel Repair Methods

Steel repairs to old bridges range from corroded column bases, which can be cased in concrete, to stringer replacements, which require rebuilding the floor. Main truss members usually do not need much repair work

except where loss of section is concentrated, as by corrosion over railroads, unless traffic accidents cause severe local damage. An account of repairs made by this division to a badly injured compression member was given in *Engineering News-Record*, Oct. 15, 1925, p. 624. In making repairs much help has been given by the bureau of tests, headed by P. J. Freeman. This bureau is well equipped for investigating and testing materials, and any questions as to their quality and fitness are referred to it.

*Bent Diagonals*—An instance of useful co-operation by the bureau of tests was when an automobile wreck on an old Pratt truss bridge had resulted in a badly bent diagonal tension member. This led to an investigation of the effect of kinking on the tensile strength of tension bars. A number of test specimens were prepared and sharp bends approximating those found in actual service were put in them. When they were broken in the testing machine it was found that the breaks never came at the bent places, which—apparently owing to the cold working of the steel—had increased in elastic limit and ultimate strength. This is valuable information and eliminates concern over ordinary bent diagonals.

*Welding Slack Tension Bars*—It is frequently noted in old trusses that one of a pair of tension members is taking more than its share of the load, while the other one acts only after the first has stretched, or not at all. Usually these bars are not equipped with turnbuckles for adjustment. An ingenious remedy has been worked out by the Pittsburgh Welding Corporation in connection with the bureau of bridges. Small plates are electrically welded to the slack bar, projecting beyond each edge of it, and turnbuckles are welded to the plates so that they are parallel to and a short distance away from the bar edges. Reinforcing plates are welded over the first plates sufficient in size to transmit the full stress of the bar. The turnbuckles have sufficient section to carry the same stress. The bar is then cut out between the welded plates and the tension is adjusted by the turnbuckles to equal that in the other bar of the pair. The turnbuckles are usually left in place, though it is feasible to weld narrower bars to each side of the main bar over the gap.

Welding has also been used to build up the sections of compression members which have been corroded, usually where they pass through the floor. This is done by welding narrow strips to the outstanding legs of the angles or other sections comprising the compression members. Tension members can be built up in the same manner.

*Floor Steel Repairs*—Much of the steel repair work due to corrosion is the result of old designs which permitted dirt to accumulate on horizontal surfaces without adequate provision for easy cleaning and painting. This is particularly the case on old bridges, of which a number were built 30 to 50 years ago with wood floors carrying street-car tracks on crossties. Floor systems are particularly vulnerable, and the tops of stringers under the crossties are usually the worst parts of the bridge. The best way to get at these is to take up the floor, renew the stringers and lay a new floor, but frequently this is undesirable owing to the length of life remaining in the old floor. In this case new stringers can be placed by setting temporary stringers on each side of the stringer to be replaced. Care must be taken to secure good bearing of the ties on the temporary stringers, usually by means of shims or wedges. When traffic can be kept off the affected stringer, only the dead weight of the floor need be sustained, but usually the maintenance man works under the handicap of having to keep traffic going as usual. When traffic permits, the wornout stringer can be removed and replaced by a new one previously prepared for quick installation. Sometimes it is more convenient to leave the old stringer in place and install a new one on one or both sides of it.

Rivets are likely to work loose in stringer connections, and often shear cracks appear in the fillets of the angles. Fortunately the replacement of these connection angles is a simple matter, particularly when adequate shelf angles are already in place. The latter are very convenient in maintenance work, and although they should not be depended on to take the load, they are worth while as safeguards and as helps to repair work.

The top flanges of floorbeams are also weak points, particularly where ties flank them on both sides, making cleaning and painting impossible without taking up the floor. Usually they consist of angles riveted on. New

WELDING TURNBUCKLE TIGHTENERS TO SLACK TENSION BARS

angles can be placed either by clearing away the ties or by taking up the floor. In practice we have replacement angles already punched to fit the rivet holes and, after removing the old rivets and replacing each with a bolt as removed, traffic is held up long enough to remove the old angles and place the new, with sufficient bolts to make the beam safe temporarily.

The horizontal planes of all the under-the-floor steel should be well painted when placed, and in addition a thick coating of asphalt and asbestos of a troweling consistency should be applied. This is a most valuable material. The bureau has a specification under which it is purchased. The right material will develop a tough skin but will remain plastic for years. It is used wherever dirt is likely to collect or the steel is under abnormal exposure to wet, and where cleaning and painting are difficult.

In the case of solid-floor bridges over railroads repairs

are likely to be of a more serious nature, requiring that the floor be removed to get at the steelwork and that traffic be interrupted. To avoid this interruption, repairs have been made by thoroughly cleaning the corroded steel, replacing the lost section by steel bars suitably placed and shooting gunite over the whole member. Not only can the original strength be restored but additional steel properly placed may furnish considerably more strength than the member had originally. It is important that vibration be kept at a minimum until the gunite has set up.

Where posts and bracing are near the ground and likely to be covered with dirt, concrete casing is the obvious remedy. Usually this is poured concrete, the location and shape of the members making concrete preferable to gunite.

### Experience With Wood Floors

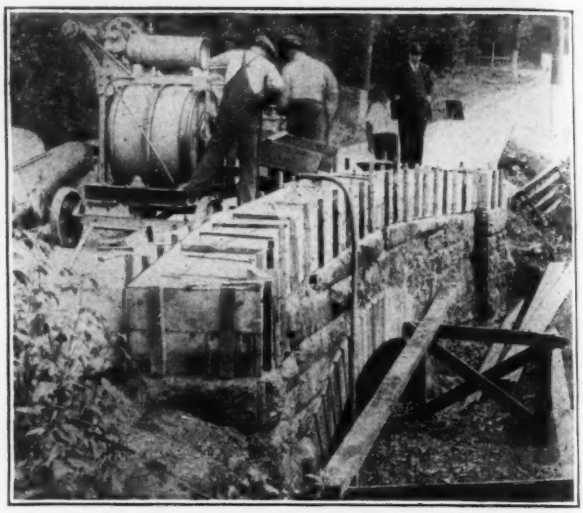
The old type of wood floors made up of crossties, nailing pieces and crossplanks is light, and many of the old bridges will not take a heavier construction. Where street-car tracks exist the construction cannot usually be changed to anything but a wood-block surface, which is undesirable due to its slipperiness when wet. Much success has been had in the past few years by rebuilding these floors in precisely the same style as before, using creosoted oak surface plank as smoothly laid as it is possible and placing steel traffic strips parallel with the rails.

*Traffic Strip Design*—These strips are of several types, all having a body about ¼ in. thick and a raised pattern of elongated diamonds or rectangles sometimes interspersed with circles. The raised pattern should cover not less than 25 per cent of the surface and should project well above the background. The plates are usually 24 in. wide except between the inside rails of the tracks, where they should cover most of that width. About 20 ft. is the most convenient length. The plates can usually be sufficiently well fastened down with small square boat spikes which will just go through the ⅜-in. holes punched in the edges and ends of the plates. The spikes should not go through the plank. For 3¾-in. plank 3½-in. spikes are used. It is surprising how well these short spikes will hold in oak when spaced 8 to 16 in. on centers. Lag screws were tried, but many of the heads twisted off before the screws were down, particularly in oak.

*Value of Traffic Strips*—The plates last well, as the wear under the predominant rubber-tired traffic is small, and being of copper-bearing steel they do not rust rapidly. The surface of the background corrodes at the same rate as the projections and the dimension which insures long life is the thickness of the body of the plate, which is to be increased in future orders. The bureau has recently replaced wood-block floor of 3½-in. blocks on 2¾-in. plank with a solid floor of 3x6-in. creosoted oak on edge, spiked solid, protected from wear by a solid plating of traffic strips. The floor has practically the same weight as before but is several times stronger, its effective depth considered as a beam being 5¾ in. instead of 2¾ in. Also, as the total depth is not materially changed, no adjustment of the road surface at the backwalls is required.

These plates when placed on wood-block floors reduce slipperiness. It does not pay to design a wood-block floor with plates, but on old floors that are too good to rebuild the plates are useful. It should be noted that when plates are applied to wood blocks the small boat spikes will not hold and it is necessary to use long wire spikes reaching into the sub-plank. Placing plates on wood blocks is feasible only when the blocks are laid on timber bases, as they cannot readily be fastened to concrete bases.

*Hillside Brick*—Where the steel will take the extra dead load it is feasible to lay 3-in. brick on a creosoted plank base. One installation of this kind on a grade seems satisfactory, but as it has been down only two years we cannot yet tell how long it will last. The planks are laid as closely as possible, covered with heavy tar paper, and hillside bricks are laid in asphalt with asphalt joints. Angles bolted to the plank at intervals of 20 ft. run across the bridge to keep the brick surface from sliding down hill. This is an experiment to develop a comparatively light non-skid floor for grades of about 6 per cent.



RAISING PARAPET ON OLD MASONRY ARCH

*Non-Skid Coverings*—There are a number of large bridges with wood-block floors in Allegheny County and their slipperiness has caused much concern. Two of them have been treated with a tar and slag mat, which is very effective but which does not adhere well, so that it must be renewed every summer. However, conditions are such that this is preferable to no treatment.

*Wood-Block Troubles*—It will be observed that much of this floorwork is an attempt to secure a good substitute for the light and durable wood blocks. Their great defect is their slipperiness, which did not matter so much when traffic was slower. The blocks also absorb some moisture, so that when laid without suitable expansion joints and confined within rigid bounds they will heave. If repairs do not make them watertight, frost will get under them and the floor will be ruined. For this reason their use should be confined to dry places, where they are ideal for heavy duty.

### Painting Practice and Problems

The painting of steelwork becomes steadily more important as larger and heavier bridges are built. The whole question of protective paints was studied in connection with the bureau of tests during an entire winter. Specifications were finally drawn which have been modified slightly in the last three years. The first year about $7,000 was saved over the previous year's expenditures. There is now a good list of paints upon which all manufacturers bid.

*Painting Practice*—Bridges under construction are painted with the same specification paints as are used by the maintenance division; they are furnished by the steel contractor, who has them mixed under county inspection. Any paint left over can be taken into the maintenance stock and the latter can be drawn on when small quantities are needed in a hurry.

Large bridges are usually painted dark green above and black beneath the roadway. Aluminum paint is used in special cases, particularly for handrails and lampposts. Small bridges are painted a light gray above and black underneath. The light color is used to make them more visible at night to automobilists. When repainting an old bridge, the practice is to paint only bare steel with the shop coat, after which two top coats are applied. Colors are so varied as to permit of ready identification and inspection of the various coats. It is usually found expedient to paint small bridges once every three years, since mechanical wear and dirt are especially prevalent on them. Large bridges go longer without repainting, but five years should be the maximum, as there are always parts that suffer by wear which even the best paint cannot withstand. We believe that too much stress can be laid on weathering action when wear may be the dominating factor in paint deterioration.

*Cleaning Important*—The most important thing about painting an old bridge is the preliminary cleaning. The best paint made will be wasted if placed on dirty or scaly steel. Our practice is to knock off all loose scale, allowing tightly adhering rust to remain and wire-brushing carefully before applying the paint. Old paint films are checked over and all blisters cut out and the loose edges cut back to firm film. All bare steel is covered with a "shop coat" and the whole structure then given one or two "field coats," as judgment dictates.

### Inspection Practice

The inspection system is important. All bridges are checked up whenever possible by the superintendent and his staff. In addition a bridge inspector, who is a structural iron man, makes a regular inspection of the important bridges, reporting in detail the conditions found. A special report blank is employed for this purpose with all the parts of a bridge listed. These reports are checked in the office and filed.

*Bridges Have Code Numbers*—Owing to the large number of small metal bridges, it is often difficult to decide which bridge is meant when a local resident calls up to report trouble. Each bridge is therefore given a code number and when the bridge is painted there is stenciled on it a request that in reporting trouble the bridge number be mentioned. A glance at the office bridge list then gives the exact location of the bridge.

*Inspections for Scour*—There are a number of old river bridges built on piles or grillage, and these are subject to scour when the rivers are high or ice-filled. In order to guard against dangerous conditions around the piers, an inspection is made each year when the water is low and soundings are taken. A motorboat, which is part of the regular equipment, is used with a skiff in tow. The actual soundings are made from the skiff, as it is easily moved about and accurately located. The soundings are carefully kept in the manner of ordinary survey notes and are filed after being studied. When found necessary, stone for riprap is placed in the scoured places. At the same time that the soundings are made observations are taken on the under side of the bridge floors and defects are noted. For this purpose a high-powered binocular is very useful. The motorboat is capable of towing a small barge to piers that need pointing and repairs can be made without an excessive amount of scaffolding.

*Handling Emergencies*—With the best of arrangements for inspection and repairs emergencies will arise, and dealing with them is a subject about which much could be written. Fire is frequent on wood floor bridges, especially in dry weather, when a carelessly thrown cigarette stump can start a bad blaze. On bridges of this kind water barrels and buckets are placed at suitable intervals. The watchman are required to patrol the bridges periodically looking for incipient fires. In case one of these gets out of control the nearest fire department is called. We are fortunate in having plenty of these well distributed.

Collisions and wrecks frequently tie up traffic and damage the bridge structure itself. Each of these has to be handled as appears best at the time. Sometimes we are able to collect damages from a particularly reckless driver. The watchmen are useful in these cases, as they are able to get accurate information as to the cause of the accident.

All the details of a maintenance organization must lend themselves to rapid and efficient handling of emergencies. Bridges must be kept open for traffic as uninterruptedly as possible, and this fact must never be lost sight of. They are there to carry traffic, not to have work done on them, and emergencies as well as ordinary repairs must be cleared up as soon as possible. For this reason the liberal use of telephones and automobiles is important as well as a force trained to take care of the unexpected.

*Watchmen Provided*—All large bridges have watchmen, the number depending on the importance of the bridge. They have shelters which are usually built into the bridges, and it is one of the problems of design to arrange these shelters so as to be well placed for use and at the same time attractive in appearance. The watchmen clean the bridges, report trouble and tend to prevent nuisances from being committed on them.

## Annexation Provides Funds for Trunk Sewer

With the steady growth of the city of South Bend, Ind., which has now a population of 110,000, it has been difficult to supply the increasing demand for public improvements. Local and trunk sewer facilities are becoming inadequate, both in size and extent, to meet the requirements of an intensive development within the former city limits and to meet the obligations imposed by recent annexation of outside areas. The northwest section of the city in particular has been without sanitary advantages for several years, owing to the lack of a trunk sewer providing the necessary outlet to the St. Joseph River. In making the preliminary investigation for such a sewer, considerable difficulty was found in attempting to justify the apportionment of the estimated cost over the drainage area available for assessment without developing an assessment that would exceed property values. To meet this difficulty, additional areas lying within the drainage area, but outside the city's boundaries, were annexed. In this way there was provided a total benefited district of approximately 3,500 acres, over which the cost could be legally distributed without developing a prohibitive unit assessment per square foot. The construction work on this sewer was described in *Engineering News-Record* of Aug. 2, 1928, p. 173, by H. G. Wray, city engineer.

# Elements of Good Practice in High Dams

**Summarized Results of Experience in Dam Construction Presented by A. J. Wiley and D. C. Henny—Why Arching a Gravity Section Increases Stability—Shrinkage Cracks and Contraction Joints, Uplift and Seepage**

TWO authoritative papers on the subject of high dams were presented at the recent meeting of the American Society of Civil Engineers in San Diego before a representative group of builders of dams assembled there to give it attention. Both engineering design and construction were covered and in addition there was a comprehensive paper on geology as applied to dam foundations, by Prof. F. L. Ransome, of Pasadena, which will be presented in abstract in a later issue.

The paper by A. J. Wiley, of Boise, Idaho, gave particular attention to charges against the stability of arched gravity dams and, after touching on important factors involved in design, analyzed one by one the alleged disadvantages of arching dams of gravity section. As the result of this analysis he concludes that "the fallacy of these charges has been shown, and the arched gravity design, for locations in narrow canyons, can be used with confidence for the highest dams of the future."

D. C. Henny, of Portland, Ore., in treating of high dams of earth and of masonry, cited notable examples in both these classes, with comment on the constant trend in recent years toward more daring design. In addition to touching on the proper field for and the limitations of hydraulic rolled-fill and rockfill dams, he paid particular attention to high masonry dams and gave his views on good practice in high-dam design and construction. The papers by Messrs. Wiley and Henny follow, somewhat condensed in form, but in essential points retaining the language of the authors.

## *Views of A. J. Wiley*

BECAUSE of the rugged topography of Western states, giving deep and narrow canyons where high dams of short radius can be used, a great majority of such structures in the Western states have been arched in plan, whereas most gravity masonry dams built in the Eastern states have been straight in plan. The same cross-section is used in straight and arched gravity dams, on the assumption that the reduction in gravity action due to the convergence of the radii would be more than offset by horizontal arch action, and that the uplift is reduced to a negligible amount by pressure grouting and drainage.

No doubt there will be a constant improvement in the design of all types of dams and an increase in the height to which they can be safely built, but at the present time the arched gravity type masonry dam is slightly in the lead with respect to less-than-gravity arched types, and is far ahead of all other types.

*Straight or Arched Plan*—As between a straight gravity dam and an arched gravity type preference should always be given to the arched gravity type except where the length is too great to permit an arch of useful curvature. The arched gravity dam has the same stability as the straight gravity dam and in addition has the resistance of the arch. In the arched gravity type the water load is divided between vertical cantilever action carrying a part of the load to the base and horizontal arch resistance carrying the rest of the load to the abutments.

In very high dams preference should be given to the full gravity section despite the curved plan. The massive gravity action, able to carry the full load by its weight alone and having the additional resistance of the massive horizontal arch, affords the maximum safety. In the less-than-gravity arch the load is carried primarily by a more or less highly stressed arch, with the certainty that if the arch should fail the vertical cantilever would also fail.

The claim in a recent paper ("Notes on Arched Gravity Dams," by B. F. Jakobsen, *Transactions* American Society of Civil Engineers, 1927, p. 475), that there is a reduction in the strength of an arched gravity dam below that of a straight gravity dam of the same section and that this reduction in strength is greater as the radius of the arch is made smaller, is supported by the following arguments:

1. That the water pressure is applied only to the upstream face and that for the same length of face there is less resistance from gravity action in the trapezoidal section, due to the convergence of the radii, in an arched gravity dam than in the rectangular section of a straight gravity dam.

2. That because of the opening of the contraction joints or cracks in the concrete, due to setting, shrinking and cooling contraction, an arched gravity dam cannot act as an arch unless the cracks are closed by pressure grouting and that this is usually omitted.

3. That the strength of an arched gravity dam would be increased by reversing the curvature so as to have the arch convex downstream. In the case of the Exchequer dam it is claimed that if the curvature had been so reversed it would have been stronger than a straight dam and its section could have been reduced.

The fallacy of this last claim is apparent when it is seen that the two preceding assumptions, on which it is based, are in direct contradiction. If the first assumption, that the water pressure is applied only to the upstream face, is correct, then there can be no open joints or cracks and the dam must act as an arch. If the second assumption is correct, then water pressure is not confined to the upstream face but will enter the open joints and exert a back pressure upon the plane of the joints. In this case the effective pressure area is that between the joints at the upstream face less the back-pressure area, which is the projection of the plane of the joints upon the chord of the upstream face. The resulting effective area for the application of water pressure is the area between the joints and the downstream face and not the area at the upstream face, as assumed.

*Relative Stability*—As to the claim that an arched gravity dam of short radius has less stability than one of longer radius, consider the extreme case where the radius is equal to the thickness of the dam at a given elevation. The horizontal section would be triangular, and if the water pressure is confined to the upstream face, there would be no open joints and there would be arch action. If there are open joints preventing arch action, the pressure at the upstream face would be reduced by the back

pressure upon the planes of the joints, the summation of which would equal the area at the upstream face, so that at the section where the radius is equal to the thickness, if there are open joints, there would be no unbalanced water pressure to be resisted by gravity action in the dam.

Hence an arched gravity dam assumed as free from arch action by reason of open joints has a stability increased by the reduction of effective water pressure as the radius of curvature is shortened, and not decreased as claimed.

With regard to the second assumption, as to cracks preventing arch action, it should be noted that this implies the opening of the joints entirely through the dam, which does not occur.

*Shrinkage and Cracks*—Although there is shrinkage of concrete which sets in air, there is expansion of concrete which sets under water. In a massive concrete dam only that part of it a few feet in from the faces can be considered as setting in air and subject to shrinkage, and this shrinkage is partly offset by subsequent swelling when wet. At the downstream face it is largely offset by lateral expansion.

In the interior of the dam the setting is not under quite the same conditions as if submerged in water, in which case expansion would occur, but it is fair to assume that at least there would be no shrinkage due to setting.

Instead of expanding under the rising temperature of setting and contracting with the falling temperature, leaving large contraction cracks in the dam, as is often argued, the expansion causes elastic compressive stress in the concrete, and this stress is relieved without change in volume of the concrete with the reduction of the setting temperature.

Seasonal variations in temperature do not extend beyond a depth of 20 ft. into the concrete of a massive dam and they are very slight at depths of 10 to 15 ft. The opening of contraction joints or cracks in massive concrete is closely confined to the surface and does not affect at all the great mass of a gravity type dam. Such cracks extend to a maximum depth of about 20 ft. in mass concrete and any seepage therefrom either comes through a completely open joint near the top or is fed by water following a horizontal construction plane.

The logical conclusions are that, with the correct assumption of the effective pressure area, arch action can be neglected and an analysis which takes into consideration the reduction of section by convergence of the radii will show no tension in the upstream face of an arched gravity section designed as a straight gravity dam with the lines of pressure at the middle-third points. Moreover, arch action is always present in an arched gravity dam, giving it a greater degree of security than a straight gravity dam of the same section.

*Uplift Action*—Conditions that cause uplift appear to be the same at the junction with the bedrock as in the body of the concrete, and it may be concluded that there is no uplift where there is a homogeneous structure in a mass of concrete or in a rock that is free from seams or in a perfect contact between rock and concrete. At a joint in the concrete or a seam in the rock there is uplift, for which ample allowance should be made in the design of a straight dam, though in many if not most straight gravity dams no such allowance has been made.

Modern high dams are usually equipped with galleries, wells and drains for collecting seepage into and through the structure. The amount of seepage varies with the character of the rock and the height and area of the water face exposed to reservoir pressure. As it varies with the area of the dam face above streambed and also with the height, the seepage ratio should vary with the three-halves power of the height.

*Drainage*—Experience with many high concrete dams makes the value of metal stops in contraction joints open to question. Dams without such stops have proved to be perfectly free from seepage at the vertical joints in the case of arched dams.

The practice of placing vertical drains close to the upstream face of concrete dams is questionable. They are supposed to reduce the percolation of water in the concrete and thus to diminish uplift and also to prevent the appearance of moisture at the downstream face. Examination of several dams where the vertical drains were omitted shows them to be as dry as others under like conditions where they were used. It seems desirable to avoid the use of any expedient which encourages the seepage of water either through the body of the concrete or through its seams or joints.

Seepage at the downstream face of contraction joints is usually caused by water flowing through open joints or cracks near the top where the dam is so thin as to be affected by temperature. For this reason, as well as for other conditions of design, it is desirable to make the top of the dam much thicker than stability requires, and a thickness of 30 to 40 ft. for very high dams is not too much.

## *Views of D. C. Henny*

THE design and construction of all types of high dams have been undergoing a process of evolution. In earth- and rock-fill structures the increase in height has naturally followed a more complete understanding of the effect of drainage and of selection and segregation of materials. In the case of concrete dams, advance of the art has made it possible to obtain concrete with a known strength of 4,000 or even 5,000 lb. per sq.in. in 28 days. Hence, provided a source of proper aggregate is at hand, there is no reason why concrete in the base of a dam could not be safely subjected to compressive stresses of 1,000 lb. per sq.in. or more, such as would obtain in a dam about 630 ft. in height.

*Foundation Problems*—The foundation problem is the most difficult phase of design, because in spite of elaborate geological study and underground exploration it is in its nature the most obscure, yet upon it must mainly depend the selection of type and ultimate safety. A foundation is rarely so poor as to render the construction of some type of safe dam upon it impossible. Assuming the reservoir bed to have a sufficient degree of watertightness, defects of foundation in general can be overcome by a combination of type selection, deep penetration and foundation treatment. Lack of hardness may dictate the adoption of a flexible type, and a broad spreading of load and lack of tightness the adoption of base length, enforcing sufficient length of underground water travel.

In the case of earth dams, assuming the maximum height of water against them to be definitely known and given a foundation free from such uncertain materials as quicksand and layers of marshy soil, with suitable materials for construction no limit can be assigned to the safe height of earth dams. Even clay foundations can probably be made safe in most cases by proper proportioning of slopes and top width.

In rockfill dams, with their steeper slopes, higher percentage of voids and more base area, both foundation

and building material must be of greater compressive strength. Any defect of rock material that might produce sudden settlement and destructive bulging cannot be fully cured by the adoption of flatter slopes and therefore imposes a limit upon height. Greater height also may induce increase in volume of seepage and requires greater resistance to erosion along areas where this seepage may proceed. Thus local conditions impose a limit upon heights of rockfill dams to a degree far greater than in the case of earth dams. However, with hard, durable rock base and material not subject to water softening and with other favorable conditions, no reason exists for assigning a limit of height to this type of dam short of that resulting from hardness of the building rock.

In concrete dams the increase of height imposes strict requirements on other features, such as watertightness of foundation and of structure, and also on the drainage system under and in the dam. These more exacting requirements can probably be met by increased care in bonding and in drainage design, but the foundation remains as most likely to fix the safe limit of height.

The buttress-type dam with its sloping face can be designed so as to tax the foundation to a far less extent than necessarily results from the gravity type. The resultant of dead and live load can be made to fall close to the center of gravity of the buttress-bearing area, and maximum loads can be kept down to little more than half that in pure gravity dams. Moreover, the sliding factor can be readily held down to the safe limit of gravity dams (about 0.7) and the demands upon foundation tightness are no greater, whereas the danger from uplift is much less.

*Arch Action and Deflections*—Arch action may be called to the aid of gravity dam support under a wide range of dimensions of dam sites. The single pure arch, however, with nearly vertical axis, is limited in its application to the site which permits the use of relatively short radii, otherwise it merges into the arch-gravity type. Arch dams also make greater demands upon the foundation near the top as to resistance to pressure than does the gravity dam. With a proper foundation, the height of such dams will be largely controlled by the radius or radii to which it must be built.

A notable point in the material progress that has been made in the design of arch dams of late is the indication that deflections under various conditions of loading can be foretold with considerable accuracy by model tests. This not only will permit closer determination of stresses but will also increase confidence in the correctness of design and in the safety of high arch dams.

Arching the dam of gravity section neutralizes to a great extent the danger from flood toe erosion, and this in many cases may be a sufficient argument for curving gravity dams, even where considerable additional expense is involved.

Earthquake and earth movement danger is a serious factor in the selection of type and in fact in deciding whether any type of dam can safely be built, especially on the Pacific Coast. The scrupulous search for possible fault lines crossing the dam site has therefore become common practice.

The gravity arch dam is probably safest from the standpoint of storage release danger, provided it is built on a proper foundation. Its dead weight will prevent utter collapse as may occur to a pure arch, and its arch form, even if seriously distorted, will afford at least partial protection against sliding.

*Uplift*—The subject of uplift becomes especially serious in the case of high gravity dams, and careful attention must be given to the possibility of water creep along contact planes which, when the dam is loaded, are under pressure, increasing proportionately with the height of the dam. There are evidences of such creep in many existing dams in spite of efforts to secure perfect contact and notwithstanding the fact that in laboratory tests, even with indifferent contact, no such creep is observed.

Allowance for uplift generally is made in the design, but great differences of opinion exist, not merely as to the pressure gradient to be assumed (in regard to which valuable experimental data are being accumulated) but especially as to the proportionate area over which this pressure may be supposed to be effective. Generous allowance for uplift in the design and strenuous efforts to obtain watertightness and perfect bond, together with ample and effective provision for drainage, are the only safeguards which have so far been developed.

# Drainage by Pumping on the Salt River Project in Arizona

## Groundwater Table Kept Down by 160 Pumps That Raise Some 300,000 Acre-Ft. Yearly and Permit Re-use of the Pumped Water

By T. A. Hayden

*Assistant Engineer, Salt River Valley Water Users' Association*

In 1918 a full third of the 240,000 acres of land irrigated on the Salt River project in Arizona was threatened with immediate waterlogging and had a water table within 10 ft. or less of the surface. One open drain inadequately controlled the water level on a strip perhaps ½ mile wide by 6 miles long. In 1919 a pump drainage system including 38 drainage pumps was put in and improvement followed in its vicinity at once.

The system was extended by installation of additional pumping plants from time to time up to 1924. In 1925 and 1926 existing plants were enlarged and new ones constructed to make available as large a quantity of pumped water as possible to supplement the supply of irrigation water taken from the river. A few small drainage pumps have been built since, so that the total number of pumps now operated on the project for drainage and irrigation is 160. Many of the pumps deliver from 10 to 12 sec.-ft. The gross pumping capacity is 800 sec.-ft. Power for pumping is furnished from the hydro-electric power plants of the Salt River Valley Water Users' Association, the organization of 7,000 farmers which owns and operates the project.

The entire drainage of the project is effected by pumps. Some open and some closed drains were constructed, but in all cases the water table has been lowered below the bottom of the drains and they now serve merely to carry off surface or underground water discharged into them.

All but a small percentage of the water pumped on the project is used for irrigation. Nearly 300,000 acre-ft. was pumped in each year of the biennium ended Sept. 30, 1927. The greater part was used on the project. About 40,000 acres of land outside the project is supplied out of the remainder and a small amount is wasted.

Most of the pumped water is of excellent quality,

although all of it contains some alkali. On the project, pumped water is discharged into the canal and lateral system and thereby becomes diluted with varying quantities of river water. From 15 to 20 per cent of water delivered to project lands is pumped. Pumped water delivered to non-project lands undiluted does not contain more than 100 parts of salt per 100,000 in addition to other solids and is considered of good quality for irrigation. There are four wells whose output runs as high as 350 parts salt per 100,000. Water from these is not used on the project and is either sold or wasted.

Different crops differ in their tolerance of salt in the water. One quarter-section was irrigated for twelve years and another section for seven years with no other water except that from the four wells just mentioned. Grain and alfalfa were grown and the land showed no injurious effects. The underground drainage was good.

At present there is not a single acre of the Salt River project land with the water table near enough to the surface to be harmful or dangerous, and less than 3,000 acres in all have water within 10 ft. of the surface. In addition the drainage system has been converted from a liability to an asset through receipts from the sale of pumped water and assurance against drouth.

## Large Tank Equalizes Water Pressure at Springfield, Ill.

TO EQUALIZE pressure in the outlying parts of the distribution system at Springfield, Ill., and to overcome the serious drops in pressure which occur, especially during lawn-sprinkling periods in hot, dry weather, the water department has installed an elevated storage tank of 1-m.g. capacity (Fig. 2). This volume of water floats on the pipe system, which is supplied by direct pumping. The general arrangement is shown in Fig. 1.

The tank was put into service on May 8, and its successful effect was shown at once by the pressure-recording charts. For May 7, without the tank supply, the 24-hour chart at the city hall (for location see Fig. 1) showed an irregular line with pressures varying from 55 lb. down to 25 lb. For May 8, with the tank filled and floating on the line, the chart showed a very uniform curve with a variation from 44 lb. maximum to 35 lb. minimum. In addition, a recording gage placed about 100 ft. from the tank, being about 2 miles from the city hall and 6½ miles from the pumping station, showed a range of only 43 to 34 lb. on the latter date. To indicate the effect on the pumpage, it is stated that on April 23, without the tank, the maximum and minimum rates were 11.02 and 3.97 m.g.d., for 7 to 8 a.m. and 2 to 3 a.m. respectively. On May 14, with the tank in service, the figures were 10.66 and 4.83 m.g.d., for 3 to 4 p.m. and

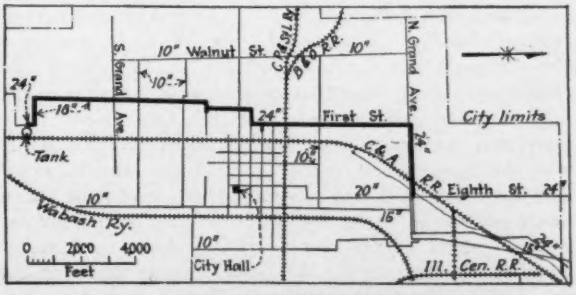



FIG. 1—WATER-DISTRIBUTION SYSTEM AT SPRINGFIELD, ILL.

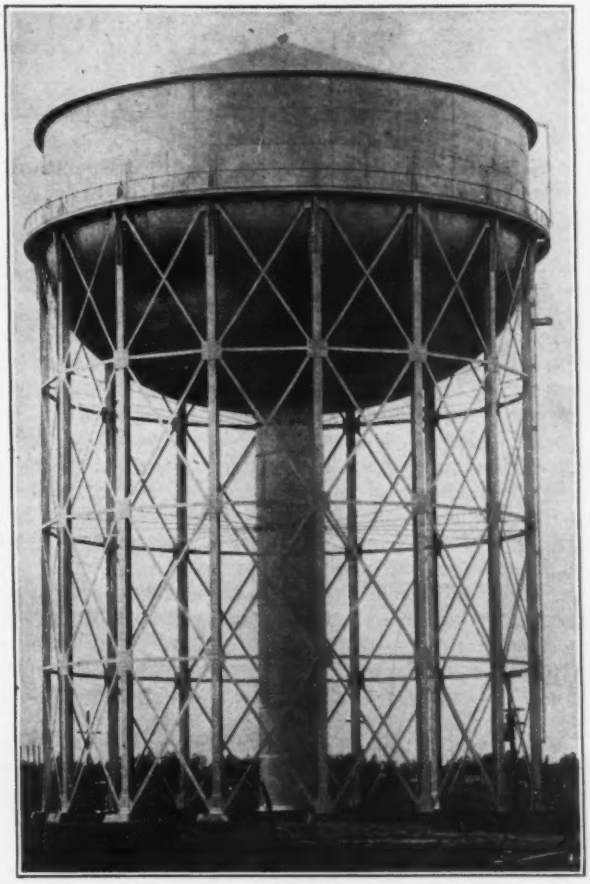


FIG. 2—ELEVATED WATER TANK OF 1-M.G. CAPACITY

1 to 2 a.m., respectively. In hot weather the pumping rate reaches 14 m.g.d.

As the tank is of large diameter, 72 ft., it is supported by sixteen vertical columns of 14-in. H-beams, which are riveted directly to the shell. They stand on independent concrete footings, without piles, the footings having steel reinforcement in the bottom and a grillage of two rows of I-beams in the top. A 10-ft. riser extends 60 ft. to the elliptical bottom of the tank, which is 23 ft. deep and is surmounted by the cylindrical shell, 17 ft. deep, the top being 100 ft. above the footings. The method of erection was in our issue of Oct. 11, 1928, p. 556.

This use of an elevated storage tank to equalize pressure and improve the distribution was suggested by Harry F. Ferguson, chief sanitary engineer of the State Board of Health. Estimates made by the Burns & McDonnell Engineering Company, of Kansas City, Mo., showed that to enlarge the facilities and increase the capacity of the distribution system so as to be adequate to give proper pressure during peak demands, without elevated storage, would cost about $763,340, while with a 1-m.g. elevated tank the cost would be only $317,975. Of this latter amount the tank and foundations represented about 20 per cent, the remainder being for additional trunk pipe lines to and from the tank. When these pipe lines are completed, the pressure equalization will be still more effective. The tank was built by the Chicago Bridge & Iron Works. All these improvements were designed and carried out under the direction of Willis J. Spaulding, commissioner, department of public property, Springfield, Ill.

# Engineering Side of Public Health Discussed at Chicago

## Section of American Public Health Association Deals With Financing of Water Supply and Sewage Disposal, Control of Odors and Tastes in Public Water Supply and Research in the Disposal of Wastes

AMONG the many topics covered by the public health engineering section of the American Public Health Association at its meeting in Chicago, Oct. 15 to 19, were financing water supply and sewerage, watershed sanitation, control of phenol tastes and odors by keeping phenol wastes out of water supplies, research in the disposal of garbage, sewage and industrial wastes. Sanitation of milk, shellfish and bathing places, schoolroom ventilation and other topics were also considered. There were groups of papers or symposiums on half a dozen or more of these subjects, in some cases occupying an entire session. A number of committee reports were presented. The sum total of papers and discussions was large and the subject matter of many important, as will be seen from the summaries that follow. The business proceedings of the section are covered in some notes on the A.P.H.A. convention given in the news pages of this issue.

*Financing Water Supply and Sewerage*—Nearly a whole session was devoted to financing water supply and sewerage improvements. Sewerage financing was taken up by Langdon Pearse, sanitary engineer, Chicago Sanitary District. The cost of some of the Chicago sewers was met from water-works revenue, on the ground of protection of the water supply by getting sewage out of the lake. In Illinois, assessment of benefits to provide money for sewerage systems cannot be extended to cover sewage-works, because, it is held, they are not a special benefit within the meaning of the statute. H. F. Ferguson, chief engineer, Illinois Department of Health, said that Illinois cities have a bonded debt limit for all purposes of 5 per cent of the assessed valuation, but sanitary districts, following watershed lines, may be organized and may issue bonds up to 5 per cent of the assessed valuation of the sewerage district, besides which the districts may, on popular vote, levy a limited tax for sewerage improvements.

The method of financing water-supply improvements under the Ohio sanitary district law, exemplified by the Mahoning Sanitary District, was described in a paper by W. H. Dittoe, chief engineer. The assessment commissioners divided the cost among the municipalities composing the district according to relative benefits to each, but no attempt was made to assess individual property owners according to benefit. At New Orleans, stated George G. Earl, chief engineer of the water and sewerage board of that city, funds for the operation and maintenance of both water and sewerage systems are collected in one bill, based on the amount of water used. The discussion brought out the fact that at coming November election Grand Rapids, Mich., will vote on the sewer rental plan.

*Watershed Sanitation*—A strong stand for the sanitary protection of water-gathering grounds to the exclusion of recreational uses was taken in a paper by E. Sherman Chase, of Metcalf & Eddy, Boston. Such protection is important where storage alone or that and chlorination are the only agents to counteract pollution. Hunting, fishing, boating and bathing were all held to be dangerous—particularly bathing. Returns from 46 state sanitary engineers showed that only eight have specific statutory authority to control pollution of water-gathering areas, with only four that exercise it—Massachusetts, New York, North Carolina and Vermont.

The New England states, where control prevails, have the lowest typhoid rate of any state group, Mr. Chase said. As an example of protection by ownership the speaker cited the Wanaque watershed, where 62.5 per cent of the area has been bought by the North Jersey District Water Supply Commission for Newark, Paterson and the six other municipalities composing the district. H. E. Moses, of the engineering division of the Pennsylvania Department of Health, emphasized the growing public insistance on recreational use of water-gathering areas. Pennsylvania has come to believe that no surface supply is safe without at least chlorination. F. H. Waring, engineer, Ohio Department of Health, said that in Ohio conditions are such as to demand both filtration and chlorination. In general, water has to be taken directly from streams, without storage. Columbus, with large storage, has 1,000 square miles of drainage area back of its dam, upon which are cities. Ownership of the watershed is impossible. Where reliance is placed on marginal strips around reservoirs, 300 to 400 ft. is insufficient; the Mahoning Sanitary District will own a 1,500-ft. strip; more would be better. W. J. Scott and X. H. Goodnough, of the Connecticut and Massachusetts health departments, supported Mr. Chase in his stand for rigid sanitary control, but Mr. Goodnough stressed the fact that much depends upon local conditions. Massachusetts, through state ownership of all "great ponds," can regulate the use of natural storage reservoirs as it sees fit. The state is so densely populated that most members of the legislature fear that sooner or later there may be an attempt to do the like for the "pond" from which the supply of his city or town is drawn.

*Phenol-Chlorine Tastes and Odors*—The disposal of phenol wastes from byproduct coke ovens and gas plants in its relation to tastes and odors in water, particularly chlorinated water supplies, was the subject of an entire session in which ten or a dozen men took part, including prominent men in the industries. The first group of speakers included F. H. Waring, of Ohio, W. L. Stevenson, of Pennsylvania, and C. A. Holmquist, of New York, each chief engineer of the corresponding state board of health, and all addressed themselves to the Ohio River basin interstate stream conservation agreement, under which, with the co-operation of the U. S. Public Health Service and the coke, steel and gas industries, nearly all phenol waste production in the area indicated has been controlled and a system devised for notifying down-river water-works when an accident or "spill" occurs in order that the works may take precautionary measures.

The first control measure was use of the phenol-

bearing liquids for coke quenching, this resulting in evaporation. Later, and now more in favor, are liquor-treatment methods, for the removal of the phenol. The part the industries have taken in control works was described by F. F. Marquard, assistant general manager, Carnegie Steel Company, Clairton, Pa., F. W. Speer, Jr., director of research, Koppers Company, Mellon Institute, Pittsburgh, Pa., and C. L. Waggoner, superintendent coke-oven plant, By-Products Coke Corporation, Chicago. The technique of the processes that produce and that treat phenol wastes was given in this group of papers and by Mr. Waring.

A third part of the symposium described studies of the biochemical oxidation of phenol wastes at Chicago, by F. W. Mohlman, chief chemist, Chicago Sanitary District, and at Rochester, N. Y., by William A. Ryan, chemist, department public works. Mr. Mohlman's conclusions were that caution should be used in admitting phenol wastes to sewage-works, on account of the high oxygen demand this entails, and accentuated dangers of trouble in winter.

In the course of the entire group of papers it was brought out that phenol in water in the ratio of 1 part in 50 billions may produce taste, while as an illustration of the fact that there are other possible sources of phenol trouble than coke and gas plants it was stated that 1 qt. of lysol discharged from a hospital might product taste or odor in 50 billion quarts or 12,500 m.g. of water.

*Sewage Wastes Research*—The closing session was devoted to research in the disposal of garbage, sewage and industrial wastes, together with an account of a notable lawsuit over the discharge of treated sewage into a stream.

To throw light on the question whether garbage can be "digested with settling sludge," as tried at Lebanon, Pa. (see *Engineering News-Record*, May 15, 1924, p. 857), Gordon M. Fair, assistant professor, and Louis Klein, research assistant, in sanitary engineering, Harvard University, presented a paper outlining tests with comminuted garbage mixed with fresh sewage solids and also with ripe sewage sludge at a 200 to 45 ratio, the available data indicating an average annual garbage production of 200 lb. per capita in New England and an observed annual average of 45 lb. of settling sewage solids at Fitchburg, Mass., from which place the sludge for the studies was obtained. The tests were made in sealed glass jars, with provision for gas removal and with and without pH control. The conclusions of the tests were unfavorable to the use of the "Lebanon plan" until "suitable methods for controlling digestion and designing digestion tanks have been developed." With adequate control, the tank capacity for garbage and sludge would have to be five times that for sludge alone.

The lawsuit over the discharge of sewage brought against the city of Brockton, Mass., was described in a paper by Harrison P. Eddy, Boston, Mass. Brockton put settling tanks and intermittent sand fitters in use about 1895 and added sprinkling filters considerably later. The effluent discharges into a small stream. Land owners claimed that vegetable growth in the stream checked the flow and waterlogged their land so as to make it worthless. They were awarded damages to the extent of the value of the land for agricultural purposes. The moral of the tale is that even a well-purified sewage requires adequate dilution.

A questionnaire to elicit information on the value of hydrogen-ion control in sewage-sludge digestion, sent to engineers and sewage-works operators by Frank Bachmann, of the Dorr Company, New York City, brought 30 usable replies, of which ten related to Imhoff tanks and twenty to separate sludge-digestion tanks, mostly in the East and Middle West. So far as digestion is concerned, most of the replies were favorable to the use of lime. A tabulation and summary relates also to adjustments of pH values, form and method of adding lime, foaming, and permanency of pH value and its control.

A plea for co-ordination of research in sewage and industrial wastes was made by Clarence M. Baker, lately engineer, Wisconsin Department of Health, now engineer of the American Paper and Pulp Association, New York. A paper comparing the effects of "stream flow" and diffused air on packing-house wastes was presented by Max Levine, Harry Jenks and F. G. Nelson, Iowa State College, Ames, Iowa. (See *Engineering News-Record*, May 24, 1928, p. 808, for description of stream-flow activation.) "Some Biochemical Factors in Sludge Treatment" was the title of a paper by Willem Rudolfs, chief, department of sewage disposal, Agricultural Experiment Station, New Brunswick, N. J., which brought out an extended discussion. Studies believed by the author to show that the sulphite-reducing bacteria afford a better index of water pollution by human wastes than do either the B. coli or B. aerogenes group were summarized by Frank E. Greer, principal bacteriologist, Chicago Department of Health.

*Committee Report*—For the committee on scope and policy, Robert S. Weston, Boston, Mass., reported, among other things, that "the important function of the public health engineering section is so to conduct its meetings as to inform 'lay and professional members of the association . . . through papers which connect engineering methods and accomplishments with public health work.'" The committee on public health engineering education, through Axel Wolman, chief engineer, Maryland Department of Health, reported that sixteen colleges in the United States have courses in sanitary engineering, mostly orthodox civil engineering courses with a sprinkling of chemistry and bacteriology but very little on public health subjects. The best courses are found where there is a prominent sanitary engineer on the faculty. A clearer idea is needed of what should be the minimum requirement for entrance on a sanitary engineering course before attempting to lay out the course itself.

## Largest Steam Turbine Under Construction

A turbo-generator now under construction by the General Electric Company for the New York Edison Company is believed to be the largest single-shaft, single-unit electric generator in the world. It will be located in the new East River generating station of the New York Edison Company at Fourteenth St. The machine will develop 160,000 kw., or 215,000 hp.

The steam-generating units to be used in connection with the new turbo-generator will also be of unprecedented size. Four units will be installed, having an aggregate heating surface of 45,120 sq.ft. each. Each of the four will produce 550,000 lb. of steam per hour.

In addition, the generating station will contain the largest pumping station in the world, with a total capacity of the circulating pumps of the condensers of 1,400,000 gal. of water a minute. This is double the quantity of water used by the New York City water supply. It will be taken directly from the East River and returned as rapidly as used.

# Repairing a Truss Bridge Under Traffic by Arc Welding

## Structure at Bound Brook, N. J., Receives New Floor Beam Flanges and New Bottom Chord and Web Members in Its 86-Ft. Trusses

By L. B. Woodruff

*Construction Engineer, Public Service Co-ordinated Transport, Newark, N. J.*

REPAIRS to the C St. bridge, Middlesex Borough, near Bound Brook, N. J., have been successfully carried out by electric arc welding. The structure is primarily a trolley bridge and consists of two pairs of pony trusses, each 86 ft. long, spanning the tracks of the Central Railroad of New Jersey and the Lehigh Valley Railroad. There is a single trolley track and 11-ft. driveway between the trusses, with a sidewalk for pedestrians on the outside of one of the trusses. The repair work included the replacement of the bottom chord and diagonal members of all four trusses by new members welded in place, the reinforcement of other corroded parts of the trusses where necessary, the removal and replacement of brackets carrying the footwalk and I-beams and channels carrying the roadway, the removal and replacement of the top and bottom flanges of the floor beams that were seriously corroded and the painting of the entire structure.

Railroad service beneath the structure made shoring difficult, if not practically impossible. Such shoring would also have probably stopped trolley operation and made the cost of repairs so high that it might have been cheaper to build a new bridge. The method of repair adopted permitted trolley schedules to be maintained as usual and eliminated the necessity of any shoring over the railroad tracks.

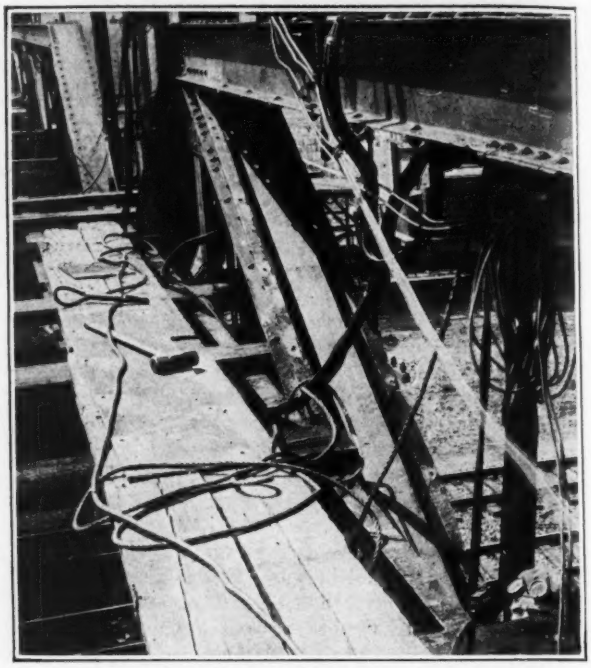


FIG. 2—NEW WEB MEMBER IN PLACE INSIDE OF OLD DOUBLE CHANNEL MEMBER

Difficulty in repairing the trusses during trolley operation was ingeniously overcome by keeping the existing latticed channels in place and inserting the new steel inside of them, cutting only enough of the lacing to permit entry of the new members, which were welded to the existing gusset plates. All new members were designed for the entire load as if the old members were not present. For the lower chords 10-in. 56-lb. H-sections were used, while 6-in. 27½-lb. H-sections comprised the new web members.

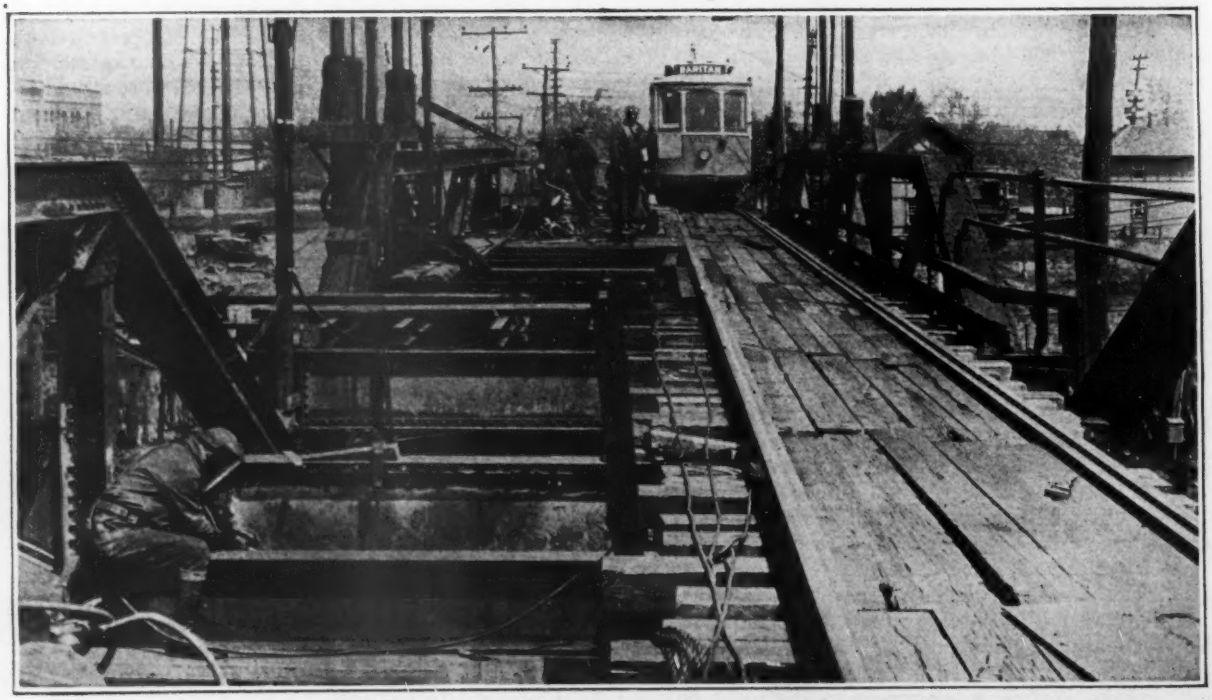
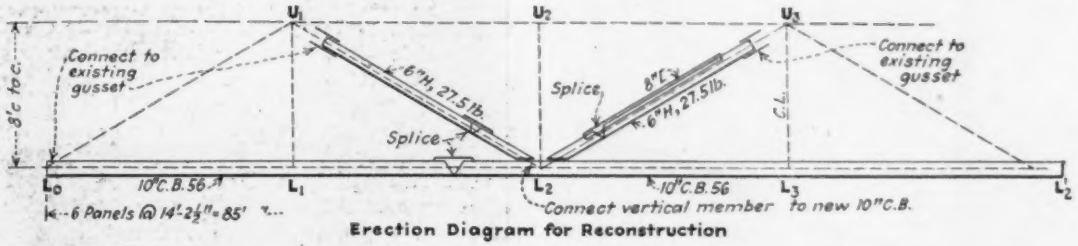
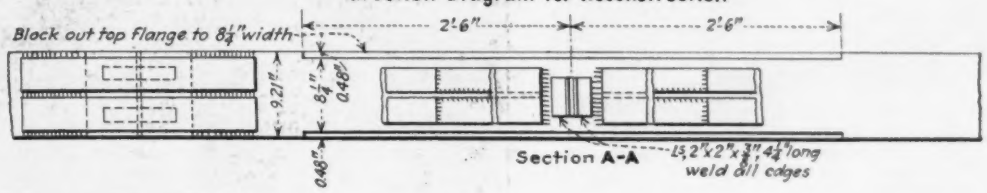


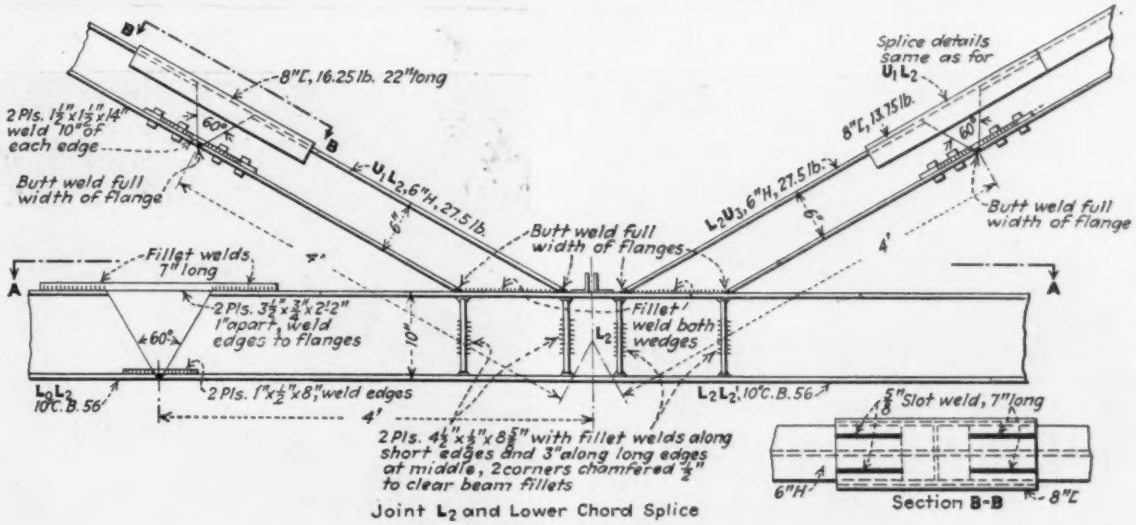
FIG. 1—REPAIRING TWO 86-FT. TRUSSES BY ARC WELDING



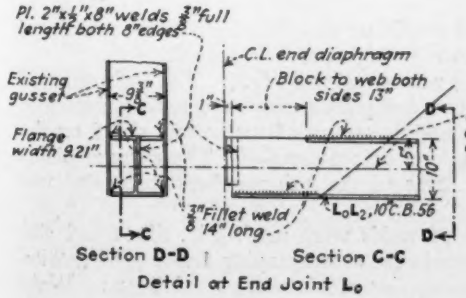

Erection Diagram for Reconstruction




Section A-A

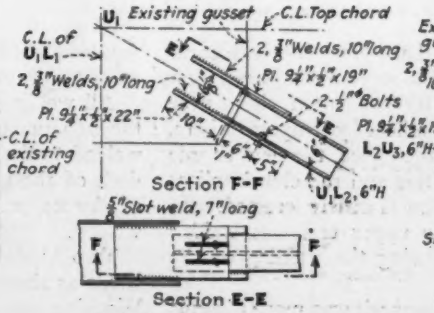



Joint L2 and Lower Chord Splice



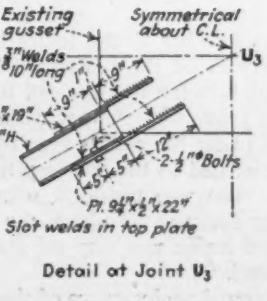

Section D-D Section C-C

Detail at End Joint Lo

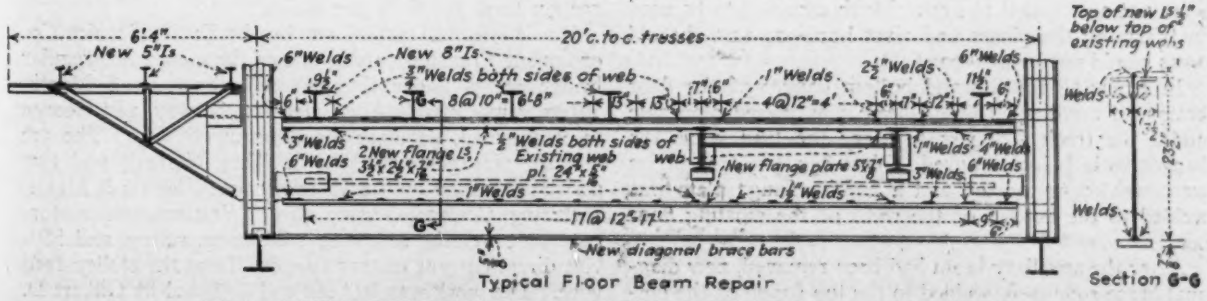



Section E-E

Detail at Joint U1




Detail at Joint U3




Typical Floor Beam Repair

Section G-G

FIG 3—WELDED STRUCTURAL DETAILS USED IN REPAIRING 86-FT. TRUSS SPANS

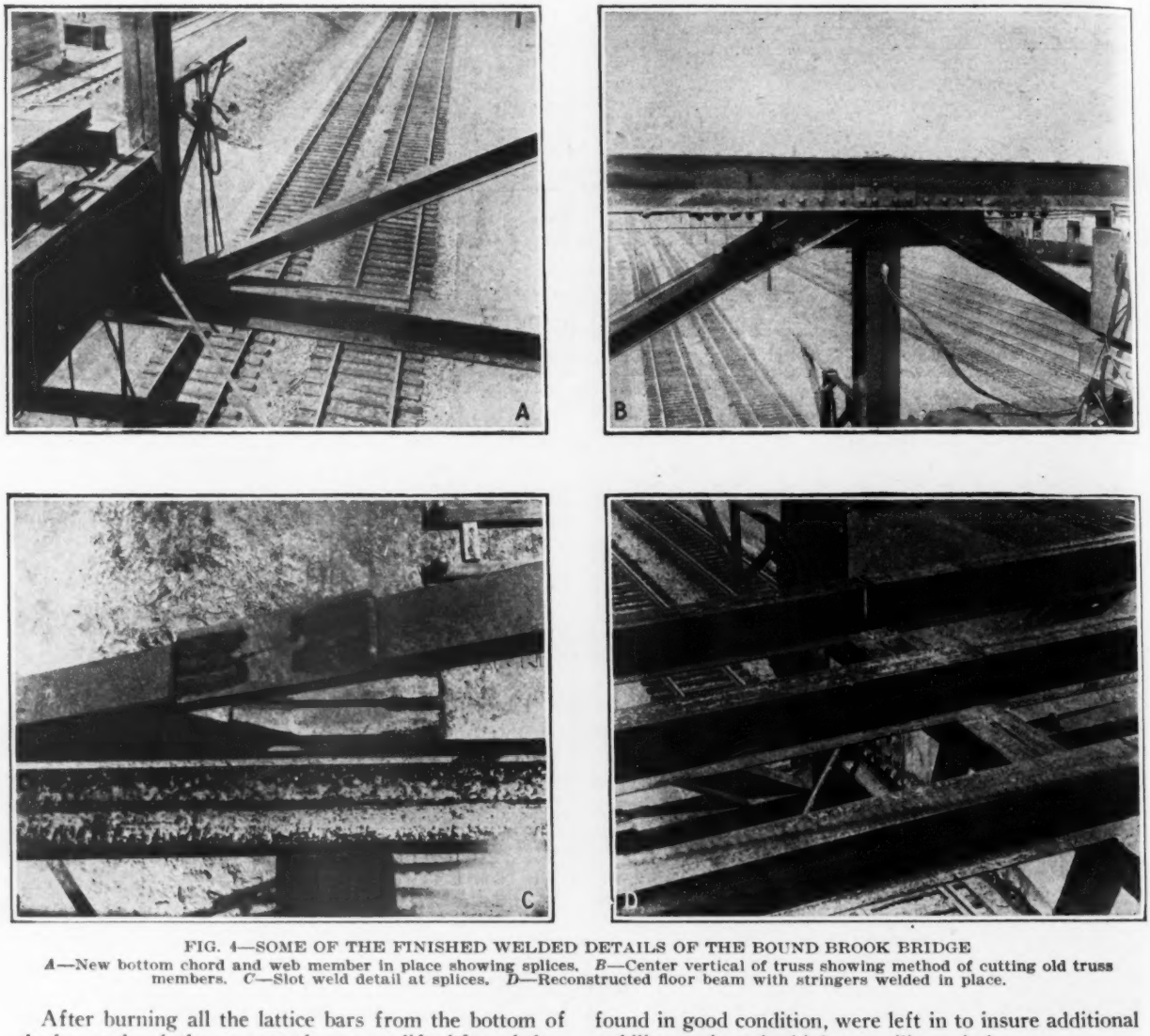



FIG. 4—SOME OF THE FINISHED WELDED DETAILS OF THE BOUND BROOK BRIDGE
*A*—New bottom chord and web member in place showing splices. *B*—Center vertical of truss showing method of cutting old truss members. *C*—Slot weld detail at splices. *D*—Reconstructed floor beam with stringers welded in place.

After burning all the lattice bars from the bottom of the lower chord, the new members were lifted from below and slid between the top and bottom batten plates near the end joints. While they were held by temporary bars, welded under the chords near the splice, the new chords were fastened to the gusset plates and the chord splices made. The web members were similarly erected. In welding the web members, the upper end was welded first and traffic was stopped during the welding of the lower end.

The actual performance of the work was more difficult than is apparent, because of repairs previously made. Reinforcement plates with their rivets came to light that were not anticipated at first. Much care had to be used in trimming the plates and rivet heads so that the old truss would not be weakened.

In renewing the top and bottom flanges of the floor beams an auxiliary 18-in. I-beam was placed alongside under the track stringers to carry the load while the flanges were being removed. New $3\frac{1}{2}$x$2\frac{1}{2}$x$\frac{7}{16}$-in. angles were welded to the top and a 5x$\frac{7}{8}$-in. flange plate was welded to the bottom of the webs of the existing floor beams.

After the auxiliary beam had been removed, new diagonal brace rods were welded to the top flange of the bottom chord. The existing round turnbuckle rods, being found in good condition, were left in to insure additional stability against the high prevailing wind.

All welding was done in the field. The stub arms of the web members and plate stiffeners were assembled and welded to the middle section of the bottom chord on the deck of the bridge before erection. The channel plates of the upper arms of the web members were similarly welded.

Two kinds of welds were used, $\frac{3}{8}$-in. fillets and slot welds as shown in the accompanying drawing of details. Working stresses for welds were as follows: Weld metal in tension, 11,000 lb. per sq.in.; $\frac{3}{8}$-in. fillet welds in shear, 3,000 lb. per lin.in.; and slot welds of cross-section used, 6,000 lb. per lin.in.

The work was carried out by the Public Service Co-ordinated Transport, using one of the company's regular bridge gangs under the personal direction of Martin White, superintendent, maintenance of way, and George H. Haldeman, engineer maintenance of way. The arc welding was performed by William Norberg and two assistants loaned by the Westinghouse Electric & Manufacturing Company, using three Westinghouse motor-generator welding sets with a 200-amp. rating, and 550-volt direct-current motors supplied from the trolley feed wire. The work was laid out and designed by Gilbert D. Fish, consulting engineer on structural welding.

# Flood Control Through Slope Correction

## Symposium on an Article With This Title by W. E. Elam Printed in Engineering News-Record, June 28, p. 996

PREVIOUS to and following the printing of an article by W. E. Elam under the above title several opinions have been received as to the merits of the plan proposed and the desirability of a comprehensive study along the lines suggested by the author. Opinions as expressed below clash most sharply, which proves that there is much to be done in the way of further thinking about the subject. There is a long period of study ahead and the necessary research should go steadily forward. The installation of a hydraulic laboratory in the lower river as announced by Major-Gen. Edgar Jadwin, Chief of Engineers, in *Engineering News-Record*, Oct. 11, p. 566, indicates that he is alive to the situation.

* * *

### Mr. Elam Has Planter's Viewpoint to Protect as Much Land as Possible

Sir — While on the river I used to "speculate" as to whether it would not have been better to make the levees follow closely the meanders of the river, as they do on the lower river. From the point of view of additional area of land protected such a location would not pay. To have so constructed the levee system between the mouth of the White River and Vicksburg would have meant the abandonment of a large part of the system and the construction of a new system. Funds at that time would not have been wisely spent on any such scheme, as it was more important to strengthen the existing system at the many places where the levees had never been brought up to full grade and section and to set back certain levees where caving banks threatened their existence. During the entire existence of the Mississippi River Commission the problem has been to get the maximum flood protection from the limited funds available. Funds never permitted serious consideration of the reconstruction of the levee system so as to parallel the bed of the river and the construction of works to make the thread of the high-water flow follow closely the thread of the low-water flow. To one familiar with the depth of the riverbed the construction of dikes such as would be necessary to accomplish such a result is a rather appalling undertaking. Opposite every system of spur dikes revetment would, of course, be necessary, and the difficulty of holding such revetments would probably be greatly increased. Revetment has been carried on for many years at as high a rate of speed as funds permitted. As the caving bends are revetted the supply of bar-forming material will of course be reduced.

I cannot recall that any of the writers on stream regulation by means of spur dikes and training walls or revetments has claimed that flood heights would be reduced by such works, and I doubt if flood heights would be appreciably affected. In planning the spur dike on Ashbrook Neck I thought that possibly it might slightly reduce flood heights, but there was no flood of sufficient height before I left for the war to give me an opportunity of checking on this. The construction of this dike forced the flood flow to follow the low-water channel around the point, whereas it formerly flowed across the point. I have been informed that the dike increased the difficulty of maintaining the revetment opposite this point and that the revetment was subsequently lost, which necessitated the reconstruction of the levee. I had had a great deal of trouble holding this revetment for several years, however, so this spur dike was possibly only the last straw.

Another thing should be considered. Between Greenville and Arkansas City, where the deep bends occur, the riverbed and battures form a large reservoir. The effect of this reservoir is to make the flood heights at Greenville considerably lower than at Arkansas City. Is it not probable that if the flood flow in this reach were confined in a narrower channel conforming to the low-water channel, gage heights at Greenville would reach the same heights as those of Arkansas City, thus increasing the flood heights between Greenville and Lake Providence?

Mr. Elam is a very competent levee engineer, but his article bristles with the planter's viewpoint, which is to protect just as much land as possible regardless of cost. His article is very interesting but contains nothing new. Cutoffs such as he has proposed would, in my opinion, be disastrous. One has only to look at a map of the valley and note the crescent-shape lakes which are remnants of old riverbeds, to form a fairly good idea as to what the result of cutoffs has been in the past. Planters throughout the valley have consistently advocated the extension of the levee system so as to eliminate the reservoir areas which formerly existed and still exist in some places at the mouths of tributaries. These reservoirs unquestionably keep the heights of floods down and are the only thing, in my opinion, that can be depended upon to accomplish this result with any certainty.

General Jadwin's flood channel through Arkansas and Louisiana and down the Atchafalaya may prove a satisfactory substitute for the vast reservoir area that existed in Arkansas and Louisiana before the closure of Cypress Creek gap. The closure of this gap and the consequent closure of the reservoir area which formerly existed undoubtedly had the effect of increasing flood heights at Arkansas City at least 4 ft.

Extension of the levee system toward Vicksburg and thence back up the Yazoo would materially increase flood heights at Vicksburg and greatly increase the difficulty of protecting Louisiana for some distance above and below Vicksburg. Only a czar could get away with turning the river through a spillway into this basin if it were leveed as suggested by Mr. Elam and kept dry until the flood raised a dangerous height. I doubt whether it would be any more effective used this way than it is when the water is allowed to begin to flow into the basin as soon as it gets above the banks below the end of the levee system.

The continued reclamation of former reservoir areas is, to my mind, the sole reason for the higher flood stages of recent years. I think a halt must be called on taking more land from the river, if flood stages are not to be raised, and land must be given back to the river if flood heights are to be reduced.

J. R. SLATTERY,
Deputy Chief Engineer,
Board of Transportation,
City of New York.

New York City,
June 19, 1928.

* * *

### Time Required for Mr. Elam's Program Its Weak Point

Sir—While the paper by Mr. Elam contains numerous statements that are open to criticism, the general principles enumerated are almost self-evident. Before a river can be controlled it must first be prevented from changing its location. It therefore logically follows that the first step in improving either high-water or low-water conditions should consist in preventing the caving of banks either by revetments or by spur dikes. A low-water channel of a predetermined width should then be located within the banks thus formed, and finally the flood's flow should be so confined by levees as to follow as closely as practicable the low-water channel which has been created. This was practically the project of the Engineer Corps of the United States Army prior to the appointment of the Mississippi River Commission. The reason why such a course was not adopted is equally obvious. Neither Congress nor the people of the

Mississippi Valley would consent to such an expenditure of the funds appropriated.

There has been considerable eloquence upon the subject of improving the low-water navigation of the Mississippi River during the last 50 years, both in the halls of Congress and in river conventions. But the underlying purpose of all this agitation has been primarily the protection of land from overflow. The project subordinated land reclamation to channel improvement and would have delayed the agricultural development of the valley until an adequate navigable channel had been provided. Some engineers were of the opinion that the mere confinement of the flood discharge between levees would enlarge the riverbed, thereby improving low-water conditions, and that as an incident of land protection navigation could be improved without the necessity of large expenditures for low-water contraction. This heresy coincided with the desires of the people and therefore readily obtained Congressional approval. An act was passed creating the Mississippi River Commission, with a majority of its members believing that flood contraction would solve the woes which afflict the river. This has resulted in the creation of a levee line which protects the country from ordinary floods, but there has been little improvement in the regimen of the river. The motives which control the human mind are as immutable as the laws which govern the flow of rivers and must be taken into consideration in determining the expenditure of the $325,000,000 which has recently been authorized by Congress for the improvement of the Mississippi River.

The essential weakness in Mr. Elam's program is the time which would be required to execute it, during which the community will be exposed to overflow from floods. It will require at least fifteen years and a large part of the funds allotted to confine the river to a stable location, and an allowance of at least ten additional years should be made for correction of curvature and regulation of the low-water channel. The river will then be in a condition to permit the construction of levees to control and direct its flood flow. A long period also would be required for these controlling levees to cause such an enlargement of the river section that from 3,000,000 to 4,000,000 sec.-ft. can be carried at the same elevation as 2,000,000 sec.-ft. now flow. Whatever may be the theoretical benefits of such a project, it would leave the country exposed for more than 50 years to such a flood as occurred in 1927. If there is time between floods to execute such a project, a simple mathematical computation will indicate that it is cheaper to sustain the injury such an occasional flood would cause than to pay the interest on the funds necessary for its execution. An adequate low-water channel can be economically maintained by dredging without having recourse to bank revetment. The project, moreover, is so indefinite that it would be impracticable to submit even an approximate estimate of its cost.

Washington, D. C.
June 16, 1928.

C. McD. Townsend,
Colonel, U. S. Army, Retired.

* * *

## *Subject Should Receive Careful Study and Verification*

Sir—Through his article on "Flood Control Through Slope Correction" in *Engineering News-Record* June 28, p. 996, Mr. Elam has rendered a service to the engineering profession. The subject should receive careful study and verification if possible.

I do not believe Mr. Elam is warranted in his fears of the possibility of excessive slope on tributary streams, resulting from channel improvements on the Mississippi River. Certainly uniformity of flow is most desirable. Flow across the point of a bend not only causes slack water in the bend, reducing discharge, but it increases erosion and scour at the lower end of the bend, where the channel is narrowed by a sloping bar formation made by the cross-currents in conflict with the main stream. I am advised low water at St. Louis has been lowered 4 ft. by channel improvements.

The following comments are directed to the age-old subject of straight rivers. In eastern Arkansas in the midst of the Grand Prairie we find certain timbered and apparently elevated areas designated as Lost Island, Angelico Island, etc. However, these areas are actually depressions which hold water and support forest growth. Likewise the usual bends in an alluvial stream seem to disprove the law of direct movement of forces, when actually these streams have direct general courses, modified only by local departures in proportion to resistances encountered.

Investigations of the behavior of rivers should be governed by rational methods of analysis, whereby significant characteristics will determine controlling features as the basis of improvement plans in conformity with natural tendencies. The topography of an alluvial valley is the last engraved record of its formation.

The Mississippi River and its tributaries have experienced natural straightening due to change of conditions by levee construction and civilization. The Arkansas River has a south-side levee for about 100 miles from Pine Bluff to Napoleon at its mouth, and a north-side levee for the westerly half of that distance. Its course has shortened about 25 per cent during the past 100 years, judging from a comparison of the subdivision meander and the 1927 survey.

The beneficial effects of straightening and channel improvements should be extended into the tributaries to lower flood levels approaching the Mississippi, where high-water levels are now very materially raised by abnormal stages. A complete system of straight channels will require less expensive protection than the present treacherous bends. Also there will be good navigability. It now exists in straight stretches of the main river and its tributaries. The present flood slopes on the Arkansas near Pine Bluff are greater than may be expected near the mouth after channel improvements of both streams. Maximum velocities are not found in straight courses, but where there is less slope and greater depth, in caving bends.

Roy N. Towl,
Consulting Engineer.

Omaha, Neb.,
Aug. 21, 1928.

* * *

## *Is on the Right Track and Studies Along Lines Suggested Would Be Profitable*

Sir—I believe Mr. Elam is on the right track. There is nothing in his suggested line of procedure which is inconsistent with those formulas that have been a guide on river hydraulics in the past.

Any project for shortening the Mississippi River would necessarily have to be approached with caution and be executed gradually so as not to disturb the regimen of the stream in a revolutionary manner.

As Mr. Elam has stated, complete hydraulic data of the Mississippi River are not now available. It might also be said that they cannot be gathered within any brief period of time.

I am convinced, however, that a pursuit of studies and experiments along the lines suggested by Mr. Elam's paper would be most helpful and holds forth greater promise of an ultimate satisfactory solution of the Mississippi River flood problem than may be expected from the construction of spillways either controlled or uncontrolled.

New Orleans, La.,
June 11, 1928.

John F. Coleman,
Consulting Engineer.

* * *

## *Author's Closure*

Sir—The comments on the article are duly appreciated by the author. Most of these letters are from men who are acquainted with river hydraulics as we know it today. As Colonel Townsend states, this is practically the project advocated by Capt. J. B. Eads with the additional feature of critical slope studies and efficient river length.

It is recognized today that it is impossible to confine the river in one channel by levees alone and that diversions are necessary to avoid abandonment of the valley for agricultural purposes. Yet some doubt exists as to whether the diversions will lower the high-water line sufficiently in the middle sections of the river. Some fear scour in the upper part of the floodways and deposit in the lower. What we are really fearing is that the slope along the floodways will not be what we hope and that confining this flow in a channel of uniform width may create a new slope, either steeper or flatter than calculated. If these calculated slopes and velocities should

not prove to be correct or change by erosion and deposit after establishment, the diversion may prove inadequate or create a new channel entirely too short and with an abnormally steep slope.

A study of the slope statistics in the reach between Arkansas City and Greenville, as mentioned by Colonel Slattery, indicates that the gage relations between these points from 1882 to 1927 have varied almost directly with the actual length of channel between these points and have been little affected by flow across points or the construction of Ashbrook spur. This does not mean that it is not beneficial to the channel to prevent flow across points. But the benefit is that of enlarging the channel and not of flattening the slope, which appears unaffected by anything except character of material forming the bed of the river.

These observations indicate that a study of "critical slope" and length of channel could be the basis of study for the ultimate control of the river with a view to lowering the water line, at least in the middle portion. Some little of these data are available—incidental, but enough for the starting of experimental work.

Rivers in this country and Europe have been shortened, but no study of slope changes caused by such shortening is readily available. These data should be assembled on rivers where enough shortening has been done to give conclusive evidence. Apparent discrepancies in results may be found to be due to faulty data or to disregard of the critical slope of the soil bed in the studies.

The question of time and cost has been brought out by Colonel Townsend, as well as by others. If we only knew the laws that govern cutoffs—especially slope adjustment procedure and time—we could plan and start enough cutoffs at once to develop the discharge desired. Then intensive revetment work should be prosecuted during this development to maintain somewhere near the desired alignment. This procedure might prove quicker and cheaper than revetting the river enough to fix the present length of the channel. All cost estimates on river control are now problematical.

While the maps with the article showed parallel levees for the purpose of illustrating the feature of uniform width of channel, it should be understood that spur dikes will generally produce the same result and at considerably less cost.

There is no benefit to the outside land owners for levee protection. Most of this land is in timber, which pays better than farming, especially during flood years.

The reservoir effect will be more effective with spurs than without them.

The people in the present backwater areas, being now without any protection, could hardly prosecute a claim, because they are partly benefited by back levees, constructed to flood them at known gage heights.

The best time to withdraw excess water from the channel must be when levees are being endangered, instead of at bankfull stages as at present.

W. E. ELAM,
Civil Engineer.

Greenville, Miss.,
Sept. 20, 1928.

# Letters to the Editor

## *Wind-Pressure Assumptions in Florida Structural Designing*

Sir—Permit me to suggest a slight correction to your editorial on "Safe Factors of Safety" in your issue of Sept. 13, wherein you say, "Building practice in southern Florida, for example, is based on a 20-lb. wind pressure." Such a statement will naturally be widely read and if not corrected will shake the confidence of the laiety, both within and without the state, in the safety of the structures built and the ability of the engineers in this state.

To the best of my knowledge the structural designers in Florida have been very conservative in their assumptions and conform to the best practice of the engineering profession. The subject of wind pressures has obviously been very much under discussion since the widely heralded Miami hurricane of 1926, and in no instance has it come to my notice that a 20-lb. pressure has been advocated or used. We who have been practicing in the state for many years have used 40-lb. pressures, and there is no evidence that engineers coming from other states have used standards lower than those recommended by the best handbooks.

The lessons of the Miami hurricane seemed to confirm the correctness of standard assumptions for structural design, and if my memory is correct your own investigators made the statement that it was gratifying to find that such standard assumptions were thus justified under full-load tests. Practically all of the structural failures in that hurricane were of buildings in which there had been no engineer retained, or where for reasons of economy (?) the engineer's designs had been revised by the owner and contractor to reduce costs.

As a member of the state board of engineering examiners I have had occasion to pass on the qualifications of all structural as well as other class engineers since 1921, and certain it is that no structural man would have been granted registration who knew so little of structural design as to use a 20-lb. wind pressure.

Lakeland, Fla.,
Sept. 17.

HERBERT DRUMMOND MENDENHALL.

[Prior to the 1926 hurricane in the Miami region, the building code of the city of Miami specified a wind pressure of 20 lb. per square foot, as set forth in connection with our account of the hurricane effects in articles of Oct. 7 and 14, 1926. We are not informed as to whether the code requirement has been raised since then. Some, at least, of the buildings constructed since 1921, the date mentioned in the above reference to engineering licenses, were designed by engineers registered as professional engineers in Florida, and we think these engineers not only considered their assumptions adequate but would have had no hesitation in expressing themselves accordingly in either a technical society discussion or a statement to the board of examiners.

So far as structural-frame-and-masonry buildings are concerned, Mr. Mendenhall is undoubtedly correct in saying that the Miami hurricane effects "seemed to confirm the correctness of standard assumptions for structural design," even though these included only 20 lb. of wind. To what extent the wall masonry provided wind resistance in these structures remains open to argument. But it should also be recalled that several high radio towers failed, though their designer calculated that at least 60-lb. pressure would have been required to cause their failure.

In the absence of direct measurements of wind velocity and pressure in these southern hurricanes, as again manifested in the destruction of last month, there is room for much difference of opinion over the pressures to which a structure may be exposed. But conservative velocity estimates correspond to pressures so much higher than those commonly used in building design as to reduce these latter to the status of nominal and arbitrary conventions. Under these circumstances it seems a proper question whether the use of such conventional figures is sound practice, or whether it is not preferable to calculate for actual maximum wind loading, taking due account of all the elements of strength which resist this loading.—EDITOR.]

## *Revamping Steel Viaduct*

Sir—In my article entitled "Revamping Steel Viaduct to Carry Street Over Railroad," in your issue of Sept. 27, p. 473, first paragraph, line 4, the amount of new steel used was incorrectly stated as 70 tons. It should have read 700.

Chicago, Ill.,
Oct. 10, 1928.

THEODORE DOLL.

## *Land Elevation About Lake Okeechobee*

Sir—In looking over my telegrams sent to *Engineering News-Record* describing the damage by the September storm in the region of Lake Okeechobee, and which were published in the issue of Sept. 27, p. 488, I find that I made an error in giving the elevation of the land behind the dikes at 17 to 18. This elevation should have been given as about 16.

West Palm Beach, Fla.,
Sept. 29, 1928.

KENNERLEY BRYAN.

# News of the Week

## New York to Build Elevated Express Road Along River

### $13,500,000 Structure 4½ Miles Long Will Relieve Congestion on the North-and-South Avenues

THE New York City Board of Estimate has given its approval to the second half of the proposed elevated express highway extending along the west side waterfront, thus preparing the way for the construction of the entire structure from Canal St. to West 72d St. at Riverside Drive. The first half has already been approved, as reported in *Engineering News-Record,* Aug. 23, 1928, p. 295.

The speedway will be of steel construction, 70 ft. wide and about 4½ miles in length. Approach ramps will be provided approximately at 18th, 40th and 57th Sts. which will increase the width at those points to 99 ft. All intermediate streets will be crossed on clear spans to avoid obstructing the roadways. Inasmuch as the present streets will not be closed, the completed structure will be, in reality, a double-deck highway. Provision is made in the plans for future expansion, partly by increasing the width and partly by adding another deck, as conditions demand. The new highway will divert through north-and-south traffic from the other avenues, especially those now partly occupied by railroad tracks, thus leaving them free for local traffic.

As plans for the structure are practically complete, it is expected that bids will be called for in the near future, and that construction will start in time to insure completion in 1931.

## Award of $42,692,867 Contract Is Contested

A court order has been procured by the Del Balso Construction Corporation and the Carlton Company, Inc., contractors, from the Supreme Court of New York requiring the Board of Water Supply and Patrick McGovern, Inc., to show cause why they should not be restrained from proceeding further under four contracts, aggregating $42,692,867, for the construction of the new New York City water-supply tunnel from Yonkers to Brooklyn. These were recently awarded as a unit to Patrick McGovern, Inc., as reported in *Engineering News-Record,* Oct. 11, 1928, p. 562. It is alleged that the Board of Water Supply has acted illegally in awarding the contract to the McGovern company at the above figure, when the sum of the four low bids, taking each section as a unit, is less than this amount by about $15,000. The two complainants were low bidders on two sections of the tunnel, and the McGovern firm on the remainder.

## Committee Named to Report on Slump in Lafayette Dam

A committee consisting of three engineers and one geologist has been selected by the directors of the East Bay Municipal Utilities District of Oakland, Calif., "to examine Lafayette dam and to report with recommendations concerning present and future operations there." A large slump occurred in the newly made fill of Lafayette dam during the latter part of September, as reported in our issue of Sept. 27, 1928, p. 483. Following the subsidence, the directors of the district asked the state engineer to suggest a list of engineers and geologists from which they could name a committee of four. The committee, as selected by the directors, is as follows: Charles D. Marx, of Palo Alto; Charles H. Paul, of Dayton, Ohio, and A. J. Wiley, of Boise, Idaho, engineers, and F. L. Ransome, of Pasadena, geologist. The committee is expected to meet in Oakland on Oct. 29.

## Fritz Medal Awarded to Hoover

Announcement was made Oct. 22 of the award of the John Fritz gold medal to Herbert C. Hoover by the Engineering Foundation. The recipient was selected by a unanimous vote of a committee composed of sixteen past-presidents of the four national societies of civil, mechanical, electrical and mining and metallurgical engineers. The medal will be presented to Mr. Hoover next February at the annual meeting of the American Institute of Mining and Metallurgical Engineers in New York City.

The statement issued by the Engineering Foundation is as follows:

> By this award, which was unanimous, the board sought to express the high appreciation of Mr. Hoover's professional brethren for his distinguished attainments as an engineer, particularly in mining operations in this and other countries, and his great services as a man to his fellows.
>
> Notable among his engineering achievements are the successful introduction into other countries of improved American mining methods. His scholarly accomplishments also are worthy of mention, especially his translation into readable English from difficult medieval Latin of Agricola's famous book "De Re Metallica."

Among former recipients of the John Fritz medal are: Elmer Ambrose Sperry, Edward Dean Adams, John F. Stevens, Ambrose Swasey and Guglielmo Marconi.

## Control of Traffic in Street Discussed at Philadelphia Club

### Methods of Expediting and Controlling Traffic in Cities Reviewed by Specialists

AT a meeting held in the Engineers Club of Philadelphia on Oct. 16, a group of engineers specializing in street and highway traffic joined with local engineers in a discussion of methods of expediting and controlling city traffic. The meeting, which began with an afternoon session and continued through the evening, was preceded by one of the regular luncheon meetings of the club, at which E. W. James, of the Bureau of Public Roads, spoke on desirable reasonable traffic regulations for general use.

Difficulties in the way of efficient traffic control were described by Miller McClintock, of Harvard University, and by E. W. James. Dr. McClintock emphasized the fact that the misdirected efforts of special classes are the chief cause of many of the difficulties of city traffic engineers. Speaking from the point of view of the city traffic engineer, Burton W. Marsh, Pittsburgh, supported what Mr. James had said concerning the need for educating the public to an appreciation of the advantages to be gained from proper control of city traffic. He also stated that it had been found in Pittsburgh that only 2.8 per cent of the shoppers in a large number of the stores came in cars which were parked in the streets. Pittsburgh was the first city in this country to eliminate parking from a large section of the downtown district, he added.

The peculiarities of traffic conditions in Washington were described by M. O. Eldridge, director of traffic of Washington, D. C. There it has been found that by eliminating parking from the downtown-flow side of streets in the morning and from the uptown side in the evening much could be done to speed up traffic movement. Harold M. Lewis, executive engineer, Regional Plan of New York and Its Environs, favored compulsory off-street loading of both freight and passengers.

A paper on the function of street railways and bus lines in the transportation system by J. Rowland Bibbins, of Washington, D. C., was read in Mr. Bibbins' absence, and the subject was discussed by Lucius S. Storrs, manager of the American Electric Railway Association.

At the evening session, Hawley S. Simpson, traffic engineer, Newark,

N. J., spoke on the subject of parking and emphasized the fact that widening streets to provide parking space is a costly way of benefiting a few individuals at the expense of the whole community. He also favors off-street loading and night delivery.

Pedestrian control was discussed by Lewis W. McIntyre, Pittsburgh, and Sidney J. Williams, of the National Safety Council, Chicago. Professor McIntyre believes that segregation of pedestrian movement is the only way to insure adequate safety. He pointed out the excellent results obtained in Pittsburgh by their educational campaign.

The latter part of the evening sessions was given over to the discussion of traffic signals. Sidney J. Williams stated that traffic signals at unwarranted locations in small towns were not so much the result of good salesmanship on the part of the signal companies as it was the constant violation of the rights of the people in these small communities by drivers.

## Queens Sewer Heads Convicted

As a climax to a full year of investigation and litigation, Maurice E. Connolly, president, and Frederick Seely, chief engineer of the Borough of Queens, New York City, were both convicted by a jury on Oct. 17 of conspiracy to defraud the city. Each man was later given the maximum sentence possible under the law, one year's imprisonment and a fine of $500. Both have announced their intention of appealing the case.

Charges against the two men were brought as a result of complaints that sewer contracts were being let at excessive prices, due to wording the specifications so as to limit the bidding to one type of patented concrete pipe. It is alleged that this pipe was sold to the contractors, and by them to the city, at excessive prices.

## Texas Railway Extension Approved

The Chicago, Rock Island & Gulf Railway, a subsidary of the Chicago, Rock Island & Pacific, has been authorized by the Interstate Commerce Commission to acquire a line constructed by the parent company from Amarillo to Stinnett, Tex., a distance of 58 miles, and to proceed with construction of the remainder of the proposed line from Stinnett to the Texas-Oklahoma state line, 50 miles, at which point it will connect with a line now being constructed by the Chicago, Rock Island & Pacific Railway between that point and Liberal, Kan. The transfer of the Texas property and construction work to the subsidiary company is necessary because of a provision of the Texas laws which provide that no corporation except one chartered under the laws of Texas shall be authorized to construct, acquire or operate any railway within its boundaries.

# Paugan Falls Hydro Plant Completed on Gatineau River

### Two-Thirds of Available Power on Entire River Developed in Three Years

COMPLETION on Oct. 1 of the new Paugan Falls plant of the Gatineau Power Company, a subsidiary of the International Paper Company, marks the end of the initial development of the Gatineau River. Full utilization is now being made of the available fall from 62 miles of river, which equals two-thirds of the entire head available.

The new plant has an installed capacity of 204,000 hp. and an ultimate capacity of 272,000 hp. The dam, which is 917 ft. long with a maximum height of 150 ft., creates a reservoir 30 miles long and gives a total available head of 140 ft. on the turbines. Two other plants of the same company downstream from Paugan Falls bring the total installed capacity of machinery to the figure of 436,000 hp. Excess power from the development is utilized by the Hydro-Electric Power Commission of Ontario through a 210,000-volt transmission line with a length of 226 miles, which transports power from the Gatineau system to Toronto. The present contract calls for the delivery of 80,000 hp., which is stepped up from year to year to a maximum of 260,000 hp. in 1931.

Utilization of the Gatineau River started in 1925, since which time the three power plants mentioned have been constructed, and also a regulating reservoir 90 miles above Paugan Falls, with a capacity of 100 billion cubic feet. This is believed to be the third largest storage reservoir in the world. Unusual features of the development are that every unit has been completed within the time specified and that the final cost has varied less than 1 per cent from the preliminary estimate. The cost of the entire project is placed at approximately $80,000,000.

The contract for still another dam on the Gatineau has recently been awarded by the Gatineau Power Company to the Foundation Company of Canada. This will be at Cabonga Lake, about 280 miles north of Ottawa, and will store more than 40 billion cubic feet. Completion is expected next summer.

## Important Railway for Brazil

A 90-mile extension of the Sorocabana Railway, in Brazil, reported as authorized recently by the State of Sao Paulo, will be an important link in the railway system. At present the city of Santos, one of the principal ports, is reached only by the Sao Paulo Railway, a broad-gage (5 ft. 3 in.) line on which are located the celebrated cable inclines. The traffic is very heavy, and as all narrow-gage lines have to transfer their business, there has been for several years a project for an independent railway into the city. The Sorocabana Railway is a meter-gage line of nearly 1,200 miles and connects with other lines to form a system of about 3,200 miles.

## George W. Fuller New President of Public Health Association

Three thousand persons registered at the headquarters of the American Public Health Association and various related organizations during the conventions held in Chicago Oct. 15-19. Minneapolis was announced as the place of the 1929 convention. The incoming president is George W. Fuller, consulting engineer, New York City. He is the second engineer chosen as such to be president during the 56 years of the organization, the late Rudolph Hering having been so honored in 1912. Since then, however, Henry F. Vaughan, an engineer who has served for a number of years as health commissioner of Detroit, Mich., has been president, but by virtue of his city position rather than because he is an engineer. Dr. E. O. Jordan, of the University of Chicago, is the new treasurer of the association. H. A. Whittaker, chief of the sanitary division of the Minnesota Health Department, is one of the ten newly elected members of the council.

George W. Fuller

The association has established a William T. Sedgwick memorial medal, to be awarded for distinguished public health service, beginning in 1929. Among the resolutions adopted by the association was one urging Congress to pass over President Coolidge's veto the Parker bill for co-ordinating the Public Health Service, one feature of which would put the sanitary engineers, chemists and bacteriologists on the same general basis of rank and commission as are the medical officers of the bureau.

Officers elected by the public health engineering section were: Chairman, S. deM. Gage, chemist and sanitary engineer, Rhode Island Board of Health; vice-chairman, John F. Skinner, sanitary engineer, Rochester (N. Y.) Department of Public Works. George Putnam, Chicago, was continued as secretary of the section. The new chairman of the laboratory section is Dr. W. H. Frost, U.S.P.H.S., Washington, D. C.

Seventy new affiliations with the public health engineering division were announced. The section voted to create a committee on disaster relief, to work out a plan for action when needed, the committee to be headed by F. L. Filby, engineer, Florida Board of Health. Abstracts of papers and discussions before the engineering division appear on p. 626 of this issue.

## Suisun Bay Bridge Approved by War Department

A permit for the Southern Pacific Railroad Company to construct a 6,000-ft. double-track railroad bridge across the western end of Suisun Bay (an arm of San Francisco Bay) was approved by the Secretary of War at Washington, D. C., on Oct. 15. This bridge, which is on the main line east from San Francisco, is to cost about $12,000,000 and will replace the old car ferry now in service. More detailed information about the project was published in *Engineering News-Record*, Aug. 30, 1928, p. 329.

## Highway Discussion at Chicago Meeting to Go Unreported

Group meetings will be featured at the annual convention of the American Association of State Highway Officials which will open in Chicago on Nov. 12. In order to encourage frank comment, these meetings will not be reported, and those attending will do so on the understanding that the session is executive. Henry H. Blood, of Utah, will preside at the meeting to discuss administrative problems. Suggested subjects include: Speeding up the mapping of the United States; uniform accounting; tree planting; better sanitation along the highways; correlation of highway and air transport; use and abuse of highways by public utility companies; winter work.

O. L. Kipp, of Minnesota, will preside at the road-design meeting, where matters such as these will be discussed: Trend of highway design; standardization of road-design details; methods of estimating costs; development of highway beauty; the extent to which the central state highway office should supervise surveys and plans.

E. F. Kelley, of the U. S. Bureau of Public Roads, will preside at the group meeting on bridge design and construction. Subjects for discussion include: Pressures to consider in designing abutments and retaining walls; specifications that will insure accurate shop and field work on steel for bridges; tests for foundations.

C. H. Moorefield, of South Carolina, will direct the discussion on road-construction problems. Suggested subjects are: Proportioning materials for concrete roads; puddling of earth fills; riding qualities of road surfaces; uniform construction practice; standard equipment.

J. N. Mackall, of Maryland, will preside at a meeting to consider the following matters of maintenance and traffic control: Surface treatment of crushed rock and of gravel with bituminous materials; is the accident report card practical? landslides; maintenance of bridge floors; automatic control of traffic.

H. S. Mattimore, of Pennsylvania, will have charge of the discussion concerning materials in research. Suggested subjects include: Transverse tests as a guide in opening pavements to traffic; the year's progress in highway research; reports of tests on structures and pavements; aggregates for concrete pavement; field control of materials; essential equipment for state highway department research laboratory; how may a 1929 model cement be secured?

Budgets, accounting equipment, inventories, stores, supplies, equipment and income will be some of the subjects considered at the accounting group meeting. J. W. Gardner, of Kansas, will preside.

Jacob Hagin, of New Jersey, will preside at the meeting to consider equipment problems. Purchase, replacement, economic life, inspection and repairs will be some of the subjects discussed.

## Road Builders Announce Program and Nominations

The preliminary program for the annual convention of the American Road Builders' Association, to be held in Cleveland, Jan. 14-18, 1929, has been announced. Committee reports will be received covering every phase of highway work—administration, planning, finance, legislation, construction, maintenance and equipment—and each session will be devoted to a particular division of the association. In addition, there will be one general session of interest to all road builders, and two devoted to problems affecting contractors.

Among the individual papers to be presented are: "Trend of City Government," by William R. Hopkins, city manager, Cleveland, Ohio; "Prequalification of Bidders on Public Construction Work," by Ward P. Christie, engineer, Associated General Contractors; "Plans and Construction of Central Highway, Cuba," by M. A. Coroalles, construction engineer, Cuban Department of Public Works; "Practical Applications of Recent Highway Investigations," by A. T. Goldbeck, director, bureau of engineering, National Crushed Stone Association; "Do Construction Costs Justify Present Low Bidding?" by D. H. Sawyer, secretary, Associated General Contractors; and "Procedure for Making an Economic Survey and Plan for County Highway Development," by F. E. Schneppe, Highway Engineering Bureau, Washington, D. C.

The nominating committee of the association has made public the official nominations for officers for 1929-30, and also for directors for the usual three-year term. These are: For president, Frederic A. Reimer, consulting civil engineer, East Orange, N. J.; for vice-presidents, W. A. Van Duzer, E. B. Dimick, S. F. Beatty and Samuel Hill; for treasurer, James H. MacDonald; for directors, J. H. Cranford, Arthur W. Dean, J. S. Helm, William Ogden, William R. Smith, Frank Terrace and Charles M. Upham. Nominations by petition must be received at the office of the association, Washington, D. C., on or before Nov. 10, 1928.

## Engineering Foundation Aids Flat Slab Research

The Engineering Foundation, at a meeting held in New York on Oct. 18, confirmed the action of its executive committee in appropriating $500 to finance research being conducted at Princeton University by Prof. G. E. Beggs on small glass models of flat slabs as a means of determining stresses and strains.

Appointment of George S. Binckley, member of the American Society of Civil Engineers, to be a member of the main committee on arch dam investigation also was confirmed, and Alfred D. Flinn, director of the Foundation, was authorized to proceed with the translation of the arch dam report into the Czech and German languages. Colonel Binckley has been serving as a member of one of the subcommittees.

Marston T. Bogert, professor of organic chemistry at Columbia University, was the guest of honor at the meeting and Dr. Charles H. Herty, adviser to the Chemical Foundation, delivered the principal address, taking as his subject "Cellulose."

## Canadian Highway Leaders Hold Successful Meeting

The fifteenth annual convention of the Canadian Good Roads Association held at Regina, Sask., for three days commencing Sept. 25 was the most important ever held by that body. It was attended by about 400 delegates representing every province in the dominion, including many Cabinet Ministers and officials of the various provincial highway departments. The chair was occupied by O. L. McPherson, Minister of Public Works for Alberta. Lieutenant-Governor Newlands and Premier J. G. Gardiner, of Saskatchewan, gave addresses of welcome to the delegates on behalf of the province. Addresses were delivered by a number of the leading officials, a prominent feature of which was advocacy of the construction by the federal government of a trans-Canada highway extending from ocean to ocean.

H. G. Nicholson, assistant engineer of the Minnesota Highway Commission, told of the experiment of treating earth and gravel roads with light oils and other dust layers and preservatives of road surface, which he contended had been successful in securing greater permanency, freedom from dust and economy in construction and maintenance. H. R. MacKenzie, chief field engineer of the Saskatchewan Highway Department, outlined in detail the results of experiments in the construction and maintenance of dirt roads. T. C. Norris, a member of the Canadian Railway Commission, announced that that body would in future co-operate to the full with railway organizations, the Good Roads Association and the provincial governments with a view to reducing the number of crossings on highways.

The question of federal aid for highways was considered at length, the asso-

cration reaffirming its stand of former years that such aid be continued. Consideration of the question of the trans-Canada highway was also urged on the dominion government. Professor Clark, of the University of Alberta, presented a paper on the experiments being conducted with tar sands in the construction of good roads, which was followed by an interesting discussion. R. M. Smith, deputy Minister of Ontario Highways, gave an address illustrated by moving pictures, showing the design and construction of cement concrete highways and bridges. W. F. Rosenwald, maintenance engineer of Minnesota, outlined the methods adopted in that state of keeping roads open in winter. The election of officers resulted as follows: O. L. McPherson, Minister of Public Works for Alberta, president; D. A. Stewart, Minister of Public Works for New Brunswick, first vice-president; N. S. Lougheed, British Columbia, second vice-president; and G. A. McNamee, Montreal, secretary-treasurer.

## Building Code Revision Planned for New York City

An important result of the recent activity of technical and civic bodies in New York City for a modernization of the city's building code was achieved last week when the Mayor authorized the Merchants' Association, the leader of the movement, to prepare a general revision of the code for submission to the Board of Aldermen. The association work will be carried out under the supervision of its cabinet committee on revision of the building code, of which John Lowry, an engineer and builder of the city, is chairman. Other members of this committee are Louis K. Comstock, Stephen F. Voorhees and D. Everett Waid. The cabinet committee is part of the Merchants' Association's committee of building laws and regulations. As an aid to the Merchants' Association the city authorities have permitted Rollin C. Bastress, chief inspector in the Bureau of Buildings, to serve as a general technical adviser to the committee. The actual revision work will probably be carried out by several appointed sub-committees. It is hoped to have the suggested revision ready for presentation the latter part of the winter.

New York City's present building code was enacted in 1915 and, although there have been numerous amendments to it, many of its provisions are grossly out of date. Some of the subjects that will come up for consideration in the various committees will concern design wind loads; working stresses for reinforced concrete and a general modernization of the concrete provisions of the present code; the use of the space above theaters for office purposes, which is denied under the present code; fire-prevention provisions during the construction period; the required thickness of bearing walls; exit facilities in public places other than theaters; light and ventilation; and the inclusion of new materials and new methods of construction, under which will probably be considered structural welding. The permissable design stress for structural steel will also form a part of the work.

## HACKENSACK RIVER BRIDGE OPENED TO TRAFFIC

**One track on this new $3,000,000 bridge of the Delaware, Lackawanna & Western Railroad over the Hackensack River at Jersey City, N. J., was placed in service Oct. 14, and the two other tracks are to be opened at intervals of about one week. The lift span is 198 ft. center to center of bearings, and has a clearance, open and closed, of 135 and 40 ft. above high tide. Its design was described in *Engineering News-Record*, May 17, 1928, and an article on the construction will appear shortly. In the background is seen the old span, built in 1877, which is to be moved to another site for further service. Its low clearance of 12 ft. above high tide led to many delays.**

# *Brief News*

LINING OF THE MUSCONETCONG TUNNEL of the Lehigh Valley Railroad in New Jersey has been completed, and rails are now being laid. It is expected that the structure will be in use by Dec. 1. The double-track tunnel is 4,893 ft. long and 30 ft. wide.

FOUNDATION STUDIES AND COST ESTIMATES have been completed by the U. S. Bureau of Reclamation for raising the Avalon diversion dam of the Carlsbad (N. M.) irrigation project. Construction work on the project awaits the action of Congress.

NEW ORLEANS has completed a new coffee terminal at a cost of approximately $2,000,000. It consists of a main wharf 840 ft. long and 300 ft. wide; a two-story reinforced-concrete and steel building 250 ft. wide extending the full length of the wharf; and an adjoining single-story shed 530 ft. long. The new terminal is expected to handle more than 3,000,000 bags of green coffee per year.

KENTUCKY HAS PURCHASED TWO TOLL BRIDGES, both located in Hart County. The purchase price for the Munfordville bridge was $224,000, and $59,000 was paid for 59 shares of the stock of the Rio toll bridge. Title to the remaining 41 shares of the latter is in dispute, and no action can be taken at the present time.

THE FIRST BLOCK OF POWER from the new hydro-electric development of the St. John River Power Company, at Grand Falls, N. B., was delivered on Oct. 1 over the company's transmission line to the pulp and paper mills of the Fraser Company, Ltd., in Edmunston, N. B. The first of four 20,000-hp. units to be installed at this plant is now delivering current to an amount of 17,500 kw. A second unit is in course of installation and should be ready for operation in about six weeks.

COMPLETION OF AN IMPROVED HIGHWAY from Rio de Janeiro to Sao Paulo, Brazil, makes it possible to drive an automobile from Rio de Janeiro to Montevideo, the capital of Uruguay, a distance of approximately 1,200 miles. The only section of this road that is not built is an 80-mile stretch in Brazil, where the autoist must make use of the sea beach at low tide.

APPLICATION HAS BEEN MADE to the War Department for authority to construct a bridge across the Missouri River near Plattsmouth, Neb.

THE PILOT TUNNEL for the Gray Summit tunnel of the Missouri Pacific Railway, 1,600 ft. in length, has been completed. This is a part of the railroad's $18,000,000 double-tracking project between St. Louis and Kansas City, described in *Engineering News-Record*, Oct. 18, 1928, pp. 574 to 578.

# WASHINGTON NOTES

By Paul Wooton
*Washington Correspondent*

### Flood Control in Washington District to Be Studied—Ohio Canalization Nearly Completed

OF THE SUM available under the terms of the flood-control act for comprehensive water power, flood control and navigation surveys, $50,000 has been allotted for work on the Potomac, York, Patuxent and Rappahannock rivers. The necessary force for the field reconnaissances is being organized by Major Behon Somervell, the district engineer. The personnel of the engineer's office will be increased by four engineers and a number of employees for the field service. Some of the preliminary work in connection with the establishment of stream gaging stations has been done already by the Geological Survey. A number of stations, chiefly of the self-recording type, are now in operation. No extensive flood-control plans have been prepared except for Washington, which is practically the only large center of population along these rivers likely to suffer from an overflow of the waters. It is thought that Washington can be protected adequately by the construction of emergency levees in the low-lying parts of the city.

As to power development, there has been considerable controversy over the construction of a hydro-electric plant at Great Falls on the Potomac above Washington. The project has been opposed because of the contention of some members of the National Park and Planning Commission that power development would destroy the scenic beauty of the upper Potomac. The matter of harmonizing power development with park plans is now being considered and a decision is expected by the middle of November. There is reason for believing that opposition to power development, on esthetic grounds, is diminishing. Major Somervell is of the opinion that the construction of the power dam and of upper dams for storage purposes would be of material benefit in lessening the danger of overflow during flood stages.

### Ohio Dam Completed

The office of the Chief of Engineers has received word recently of the completion of dam No. 50 in the Ohio River near Weston, Ky. Lieut. Col. George Spaulding, district engineer at Louisville in charge of the work, has reported that there are but three more dams to complete in connection with the canalization of the Ohio. Dams Nos. 51 and 52 are reported as 83 and 95 per cent completed, respectively. Work on dam No. 53 is progressing satisfactorily, the report states.

The dimensions for the locks, which are standard for all the dams, are 600x110 ft. While the original project called for still another dam below No. 53, it has been decided that the minimum depth called for of 9 ft. can be provided more advantageously by dredging. The river widens out at this point and a 9-ft. depth has been provided already. It is thought that this depth can be maintained by dredging without any great difficulty.

## RANDOM LINES

### Small Map Scales Made Larger

Further to the quotation from the New York *Times*, given in this column in the issue of Aug. 23, the following letter to the *Times* from Colonel Jones is given:

*To the Editor of The Times:*

Basil C. Walker writes to the *Times* in connection with what the 1-1,000,000 scale map of the world would mean as interpreted in inches to the mile.

It would simply mean approximately 16 in. to the mile. The scale of 1-1,000,000 means that the map is drawn to a size that is just one-millionth of the size of the area in nature which it represents. The report which he refers to was printed in such a way as to raise his natural question. I trust this explanation will answer his question. E. Lester Jones.

Washington, D. C., Aug. 22, 1928.

This is the first time we had heard that 16 in. was one-millionth part of a mile. Evidently the *Times* is bound to misquote the colonel.

* * *

### A Highway Surveyor's End —In 1797

The following letter was clipped from *The Surveyor*, London, England:

*To the Editor of The Surveyor:*

Sir—When visiting the church at St. Anthony, Meneage, on the 31st ult., I noticed in the churchyard a tombstone with the following inscription:

> This stone is dedicated to the memory of Richard Roskinge, who was killed when in the execution of his office of surveyor of the highways by a blow on his head by a biddax, 1797. Aged 66.

It is not stated whether Mr. Roskinge was despatched accidentally or as a reward for his duties, and I understand a biddax is what we should call a pickaxe. H. T. Chapman.

* * *

### Flood Solution in a Nutshell

"For accuracy and conciseness," says Allen Hazen, "you will find the following by Earl Sparling in *Scribners* hard to beat":

> Always there will be wind and water in the South. The water can be curbed no more completely than the wind. Eventually the engineers will reach a compromise with the Devil River, but it can only be a compromise that allows the river, when it wishes, to reclaim thousands of its 27,000 square miles of natural basin. The solution of the flood-control problem will be little more than an agreement as to which parts of the South shall be flooded.

# *Engineering Societies*

## CALENDAR

**Annual Meetings**

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Springfield, Ill.; annual meeting, Chicago, Ill., Nov. 12-15.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York, N. Y.; annual convention, Biloxi-Gulfport, Miss., Nov. 13-17.

The San Francisco Section of the American Society of Civil Engineers on Oct. 16 held its regular bimonthly meeting at which two technical papers were presented. Reporting for a committee that included representatives of all California sections of the American Society of Civil Engineers, W. L. Huber reviewed findings of the committee in the matter of needed legislation affecting the supervision of dam construction by state authorities. Further work is to be done on this report before it is finally submitted. The papers of the evening were "The Balch Power Project," by Harold K. Fox, and "The San Mateo-Hayward Bridge," by O. C. Struthers.

The Texas Sanitarians Short School will be held in San Antonio, Nov. 7-10. Civil engineers will be particularly interested in the symposiums on water supply, sewage and mosquito control and general sanitation, which form a part of the program.

The Montreal Branch, Engineering Institute of Canada, was recently addressed by G. R. MacLeod, director of technical services for the city of Montreal, who read a paper on the construction of the main trunk sewer through St. Paul ward of that city.

The Engineers Society of Western Pennsylvania on Oct. 16 heard a lecture by F. H. Shepard, of the Westinghouse Electric & Manufacturing Company, on "Railroad Electrification." An all-day conference on welding is planned for Nov. 2.

The Providence Engineering Society will hold its annual banquet on Nov. 14.

The Colorado Engineering Council, at its Oct. 6 meeting, heard Irvin J. McCrary, landscape architect, speak on "Some Phases of City Planning."

The Duluth Engineers Club heard Marvin A. Northrup, of the Universal Airways System, give an illustrated lecture on "Aviation Development" at the regular monthly meeting held Oct. 18.

The Brooklyn Engineers Club, at its regular meeting held Oct. 11, heard Philip P. Farley, past-president, speak on "Brooklyn, Its Government and Engineering Problems."

## Personal Notes

Rear Admiral HARRY HARWOOD ROUSSEAU, Civil Engineer Corps, U. S. Navy, has been appointed chief coordinator to succeed General Smither.

HARRY JACOBS, member of the Louisiana State Board of Engineers, has been appointed chief of that board, succeeding the late George C. Schoenberger.

H. CARL WOLF, chief engineer of the Maryland Public Service Commission, has been appointed to represent the Baltimore Engineers Club on a citizens' committee preparing a program in celebration of Armistice Day.

W. A. SHAPARD, JR., of Shelbyville, Tenn., after a year at Yale taking an M.S. degree, is now with the Mississippi River Commission at Memphis assisting in hydraulic studies.

Lieut.-Comdr. H. C. FISCHER has been detached from duty as public works officer at the New London Submarine Base and will report to Washington. He will be assigned to the staff at Annapolis as officer in charge of public works construction.

F. H. BEEBE, head of the Western Gas Construction Company at Fort Wayne, Ind., has been transferred to the Pittsburgh office of the Koppers Construction Company, of which the Fort Wayne organization is a subsidiary. Mr. Beebe will be succeeded by W. L. WILLIAMS, JR.

V. T. H. BIEN has joined the engineering staff of the headquarters of the National Lumber Manufacturers Association at Washington, D. C. He will be engaged on the various publications being prepared by this department.

JAMES H. CULLEN, recently chief engineer for Mead & Seastone, of Madison, Wis., and New York City, on a water-power project in Janesville, Wis., for the Wisconsin Power & Light Company, has taken a position as structural engineer for the Wilson Construction Company, Inc., of Johnstown, Pa.

ORO MCDERMITH has resigned as president and manager of the Derbon Construction Company and has withdrawn from the company to re-enter the field of consulting engineering in the Pacific Northwest, with offices in Seattle, Wash. He will specialize in irrigation and hydraulic work.

L. B. ROBERTS, for the past three years superintendent of construction for J. C. Nichols on development work in the Country Club district in Kansas City, has become associated with the Tuttle-Ayers-Woodward Company, civil engineers, Kansas City, Mo., to succeed the late Charles D. Woodward. Previous to his engagement with the Nichols company, Mr. Roberts had charge of the topographical work for the New York Water-Power Investigation in New York State and subsequently had charge of similar work for the Asiatic expedition into the Gobi desert. During the war Mr. Roberts was in charge of army map reproduction work in France.

F. C. RICHARDS, formerly with the Milliron Construction Company, of Dubois, Pa., has accepted a position with the L. V. Metz Company, of Erie, Pa., as superintendent and engineer at Oil City, Pa.

CHARLES CARSWELL, formerly structural designer for the Arlington Memorial Bridge Commission, Washington, D. C., is now assistant engineer, Port of New York Authority, New York City. Before his association with the Arlington memorial bridge, Mr. Carswell was assistant engineer on the Delaware River bridge at Philadelphia.

OSCAR S. BRAY, of Dover, N. J., has resigned from his position with the Lackawanna Railroad and is now employed in the office of the city engineer of Covington, Ky. He will assist in carrying out Covington's extensive street-construction program.

H. T. CUNNINGHAM, of Allendale, Ill., has been appointed field draftsman for the Connecticut River Development Company, which is building the Fifteen Mile Falls project in the Connecticut River near Littleton, N. H., for the Grafton Power Company, a part of the New England Power Association.

A. I. CUNNINGHAM has been appointed resident engineer for the New Brunswick International Paper Company at Dalhousie, N. B.

HAROLD G. RICE, civil engineer, and EDWARD G. ATKINSON, architect, have formed the partnership of Atkinson & Rice, with offices at Rome and Schenectady, N. Y.

SAMUEL A. HART, city engineer of Sacramento, Calif., has tendered his resignation.

B. C. BELLAMY, chief engineer of the Laramie Valley Railroad Company, Wyoming, has resigned. He will be succeeded by F. J. ANDERSON.

J. G. WISE is now assistant terminal engineer for the New York Central Railroad at New York City. The following have been appointed assistant district engineers at the points named: E. E. DIETCH, New York City; J. M. CONNOLLY, Albany; R. H. KUGLER, Buffalo.

## Obituary

CHARLES B. BALL, chief sanitary inspector in the Department of Health, Chicago, died suddenly on Oct. 18. Mr. Ball was born in New Haven, Conn., in 1854. After graduating from the Sheffield Scientific School, Yale University, in 1880, he was in the engineering department of the Chicago, Burlington & Quincy Railroad and then in that of the New York, West Shore & Buffalo Railroad until 1884, when he became field inspector for the Potomac River Improvement Association at Washington, D. C. In 1887 he was assistant engineer of the city sewer division at Washington and was made inspector of plumbing in 1895. In 1902 he went to New York as chief inspector of the tenement house department. In 1904 he accepted the position of chief sanitary inspector for the Chicago Department of Health, which position he retained until the time of his death. He was a member of the American Society of Civil Engineers and had been secretary of its City Planning Division since 1923, while since 1924 he had been a member of the advisory committee on city planning and zoning in the U. S. Department of Commerce. He was a member also of the Royal Sanitary Institution of Great Britain. He was the author of "The Plumbing Catechism."

CHARLES ALFRED SHEPPARD, formerly city engineer for Edwardsville, Ill., and a member of the engineering firm of Sheppard & Morgan, of that city, was killed in an automobile accident near Omaha, Neb., on Oct. 18. He was 62 years old. A great deal of Mr. Sheppard's work had consisted of the location and construction of steam and electric railways in the Middle West, but he had also planned and supervised the construction of parts of the sewer systems at Granite City, Ill., and Edwardsville; paving and other improvement work; and levee and drainage construction. He was for several years city engineer of Edwardsville, and was also a member of the American Society of Civil Engineers.

FRANK HILL MCGUFFIE, aged 42, contract engineer for the National Surety Company, Denver, Colo., died on Oct. 17. After graduating from St. Johns College, he spent several years surveying, following which he was with the New York State Highway Department from 1911 to 1924. Since that date he had been with the National Surety Company, supervising completion of contracts, estimating, preparing specifications, advising contractors and preparing contract data for underwriters. He was an associate member of the American Society of Civil Engineers.

JOSEPH CARARA, retired civil engineer, died at his home in Pueblo, Colo., on Oct. 14. He was a native of Bordeaux, France, and came to America in 1879. He retired from active work in 1921.

ALEXANDER PRINGLE, president of T. Pringle & Sons, Ltd., architects and engineers, of Montreal, Canada, died in that city on Oct. 5, at the age of 64. He was also vice-president of the Wayagamack Pulp & Paper Company, Ltd., and was a member of the Engineering Institute of Canada.

# Construction Equipment and Materials

### Will Consider Selling Problems at Steel Meeting

In an extension of its program to cover a broader scope, the American Institute of Steel Construction, at its annual convention to be held at Biloxi, Miss., Nov. 13-17, has scheduled three addresses on marketing problems. L. F. Boffey, editor of the *Purchasing Agent*, will discuss the buyer's attitude as related to present competitive conditions; C. K. Woodbridge, president of the Kelvinator Corporation, will speak on salesmanship and present-day economic conditions; and Abram F. Myers, commissioner of the Federal Trade Commission, will speak on the powers and duties of trade associations.

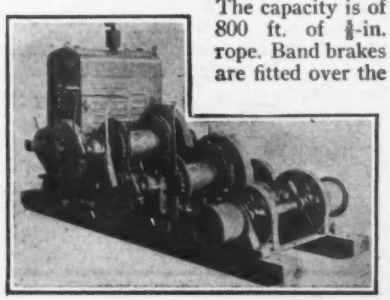
## New Developments

### Steel Grit Used in Core Drills

Steel grit, which is composed of crushed steel shot carefully screened to standard size, is being produced by the American Steel Abrasives Company, Galion, Ohio, for use in core-drill outfits cutting test sections from pavements of all kinds. It is claimed that the grit, which is used in place of the usual round shot, penetrates the pavement faster due to its sharp cutting edges.

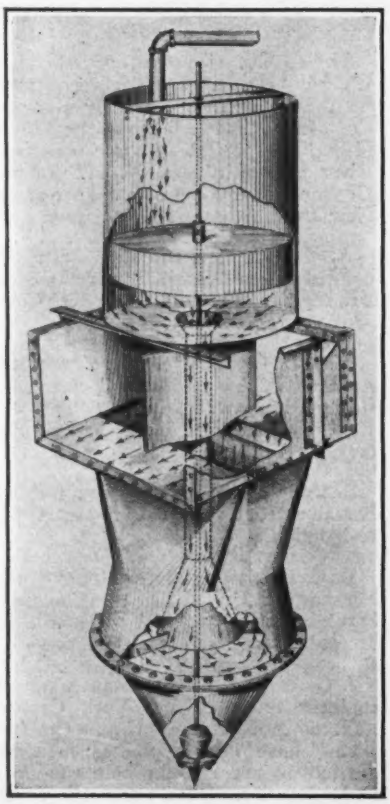
### Gasoline Hoist for Heavy Construction Work

A general-purpose hoist for construction work where a great diversity of loads is typical is now being manufactured by the Lidgerwood Manufacturing Company, Elizabeth, N. J. The new addition to the Lidgerwood line, known as the Super-Utility 40, has a duty rating of 4,000 lb. at 250 ft. per minute. It is built as a single-drum hoist, with a second drum unit available for installation either at the factory or in the field. The drums are 12 in. in diameter and have a 20-in. face, with a 24-in. diameter flange. The capacity is of 800 ft. of ⅝-in. rope. Band brakes are fitted over the friction at the gear end. These have cork inserts pressed into the maple friction blocks to increase the holding power of the brake and decrease operating effort. The drum shafts also carry 7-in. winch heads. A disk clutch mounted between the motor and the power take-off shaft permits the starting of the motor under no load. Power is provided by a gasoline motor of 40 hp.



### Sand Classifier and Cleaner

A machine for cleaning and grading sand with a more accurate sizing than has hitherto been possible has just been developed after about four years of experimentation. It is known as the Shaw classifier, and is manufactured under license by the Link-Belt Company, of Chicago and Philadelphia, which states that the new machine will produce a drier sand than any automatic settling tank but not so dry as that produced by the screw dewatering conveyor or the dewatering flight conveyor. It does, however, give a cleaner product than any of these.



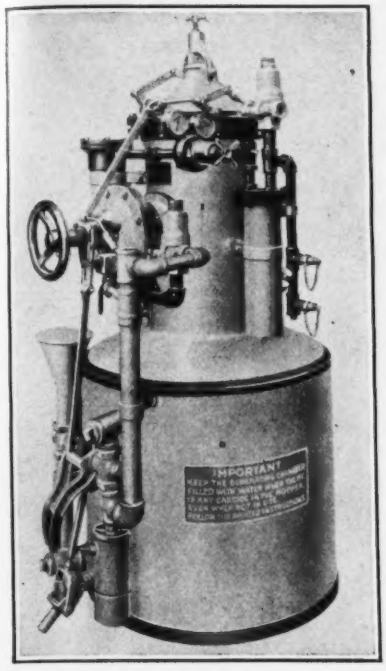
The Shaw classifier is a combination of a surface current classifier and a rising current classifier. Water, sand, dirt and other foreign matter from the washing screens flow down a slightly inclined flume and through the rectangular portion of the classifier, as shown in the illustration. A rectangular opening through which sand settles into the separating chamber below is left in the bottom of the flume. Above this is mounted a hydraulic water tank, which receives a supply of fresh water through a pipe entering at the top, the quantity of water being regulated by a hand valve to suit the work to be done. From this tank a pipe leads directly down through the flame and into the separating chamber, where its lower end is flared out like an inverted funnel. Inside of the hydraulic water tank is a float to which is fastened a vertical rod extending down through the pipe to the discharge opening at the bottom of the classifier, where a rubber-tipped valve on the end of the rod regulates the discharge as the float is raised or lowered. The pressure of the hydraulic water as it spreads out around the flared edges of the central pipe in the separating chamber is sufficient to produce a gentle upward current, lifting out any dirt, silt or other foreign particles and sometimes some of the finer grains of sand, while the larger heavier grains settle in the bottom of the cone. After the heavier sand has accumulated until it partly stops up the entrance of the fresh water, the back pressure in the float tank lifts the float, which in turn draws up the rod and its bottom valve allowing the accumulated sand to flow out until fresh water enters once more to restore the former operations of separation.

Two or more of these classifiers may be used in series to provide a separation in the sizes of sand grains by adjusting the first to take out only the heavier grains, the second to the next size, and so on.

### Large Acetylene Generators for Welding and Cutting

Three new models of medium pressure type acetylene generators are being marketed by the Oxweld Acetylene Company, 30 East 42d St., New York, N. Y. These are available in sizes having carbide capacities of 50, 100 and 300 lb., with shipping weights of 925, 1,100 and 2,300 lb. respectively.

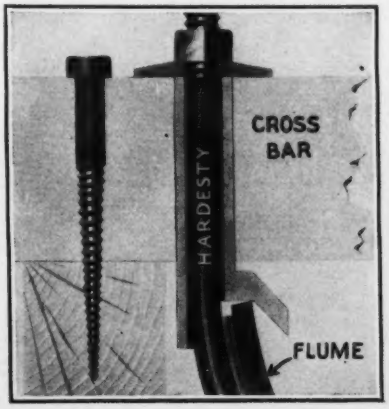
The 50- and 100-lb. models have a number of new design features to improve operation and increase safety. The feed mechanism has been redesigned to make the carbide shut-off more positive and to stop the feed completely in case of zero pressure in the generator for any unusual cause. The regulator is of the stem type, having a large stem and seat to provide ample capacity, and is equipped with two gages, one of which indicates the pressure in the generator, the other in the delivery line. The two release valves are of new design, have larger capacities and are claimed to be less likely to leak than the older type. The 300-lb. model uses a weight-actuated motor to drive the carbide feed. A diaphragm pressure control is used in connection with




the motor to regulate the speed and maintain proper pressure in the generator. The feed shaft bearing is protected by a dustproof cover. The feed motor is automatically rendered inoperative if zero pressure exists in the generator. When recharging is necessary the interference, which is of simple and sturdy construction, operates the release valve, locks the feed motor so that it cannot operate and permits the carbide doors and water-filling tank to be opened.

### Flume Shoe of Improved Design

In an effort to secure a flume joint that will remain permanently tight, the R. Hardesty Manufacturing Company, Denver, Colo., has designed a metal flume shoe made upon an entirely new




principle, which is now a standard feature of the Hess metal flume produced by that company. This type of flume is almost universally suspended from wood crossbars on timber superstructures in such a manner that the wood crossbar not only supports the weight of the flume but also becomes a part of the joint assembly. It has been the usual practice to place a compression shoe on the underside of the crossbar and a bearing washer on the top, so that when the joint was tightened a bearing force was brought upon the wood equal to that in the metal parts. Any crushing or softening of the timber led to a loose joint and consequent leakage. In the new design the stress which was formerly transmitted through the wood is taken by a metal sleeve, making it possible to draw the joint much tighter than formerly. With the new installation, the flume is dependent upon the crossbar merely for support, and any softening of the wood fibers has the effect of merely lowering the flood line of the flume a slight amount.

## Business Notes

AMES SHOVEL & TOOL COMPANY, North Easton, Mass., has not been taken over by Stone & Webster, Inc., as erroneously reported in our issue of Oct. 11, p. 569. The only connection between the two companies is that the Ames Shovel & Tool Company has employed Stone & Webster, Inc., to plan and supervise the construction of its new blade shop.

NORDBERG MANUFACTURING COMPANY, Milwaukee, Wis., has recently consolidated with Symons Brothers Company, Chicago, Ill.

BASSICK MANUFACTURING COMPANY has changed its name to the Alemite Manufacturing Corporation. The address remains the same, Chicago, Ill.

NOVO ENGINE COMPANY, Lansing, Mich., has appointed the Joe Lyons Machinery Company, Little Rock, Ark., its exclusive distributor for the State of Arkansas.

ERIE STEEL CONSTRUCTION COMPANY, Erie, Pa., has opened a Chicago office in Charge of O. H. Watson.

CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has appointed N. L. Mortensen to the post of chief engineer. T. E. Barnum, formerly chief engineer, has been appointed consulting engineer for the company.

SILAS M. HAIGHT, for the past several months research engineer for the Sweet's Steel Company, Williamsport, Pa., was instantly killed Sept. 30 when his automobile skidded on a wet road near Liverpool, Pa. Mr. Haight was formerly connected with the Highways Products Manufacturing Company, of Elmira, N. Y., and was regarded as an expert in road-construction work. He had developed numerous important improvements in highway engineering and construction. He was a graduate of Lafayette College.

## New Publications

*Wire Rope Slings*—JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., gives complete data regarding Roebling wire rope slings for handling heavy equipment, in an 84-page illustrated book, which also gives photographs showing this equipment in use.

*Iron Plates* — AMERICAN ROLLING MILL COMPANY, Middletown, Ohio, has issued a 20-page illustrated book describing Armco pure iron plates, which are now available in commercial sizes and thicknesses. Applications of the plates in the construction of pipe lines, tanks and other engineering structures are illustrated in the booklet.

*Gravel Plants* — AUSTIN-WESTERN ROAD MACHINERY COMPANY in catalog No. 83 describes the Western line equipment for crushing, screening and handling of stone and gravel.

*Quick-Hardening Cement*—MISSOURI PORTLAND CEMENT COMPANY., St. Louis, Mo., describes Prestolith Velo cement in a 15-page illustrated booklet which gives suggestions for mixing procedure to secure best results and comparative laboratory tests of Velo cement and ordinary portland cement.

*Patent Law*—RICHARDS & GEIER, 274 Madison Ave., New York City, have issued a 46-page cloth-bound book, which summarizes patent law and procedure in the United States and foreign countries.

*Gasoline Locomotives* — GEO. D. WHITCOMB COMPANY, Rochelle, Ill., describes gasoline locomotives of capacities from 2½ to 5 tons in a new bulletin, No. 2822. Specification tables, hauling capacities and many illustrations give full information regarding details of construction.

*Oxy-Acetylene Equipment*—OXWELD ACETYLENE COMPANY, of New York, Chicago and San Francisco, has issued a general catalog of the entire Oxweld line of equipment for welding, cutting, brazing, lead burning, heating and decarbonizing.

*Centrifugal Pumps*—BYRON JACKSON PUMP COMPANY, Berkeley, Calif., has recently issued three catalogs describing its product. Catalog No. 273 is devoted to multiplex high-pressure centrifugal pumps, giving details of construction and illustrations of typical applications of multi-stage centrifugal pumps to waterworks, drainage, pipe-line service and mine dewatering. Catalog No. 283 is devoted to deepwell turbine pumps for drainage, irrigation and water supply. Catalog No. 288 F describes the application of centrifugal pumps to fire-fighting apparatus, including high-pressure booster pumps and units for use in fire apparatus on land and sea.

# The Business Side of Construction

## Old-Fashioned Home Gives Way to the Multi-Family Home

The U. S. Bureau of Labor Statistics has brought together some interesting information regarding the new construction that has taken place in recent years. The accompanying diagram based on this information shows the percentage of the total number of families provided for by new building in 257 cities during the period 1921 to 1927 distributed as among one-family, two-family and multi-family dwellings. The diagram herewith shows that in the entire period less than one-half of the new provision for family residences was in one-family houses and that the multi-family house, which a generation ago was unfamiliar in most American cities, provided for well over one-third of the families.

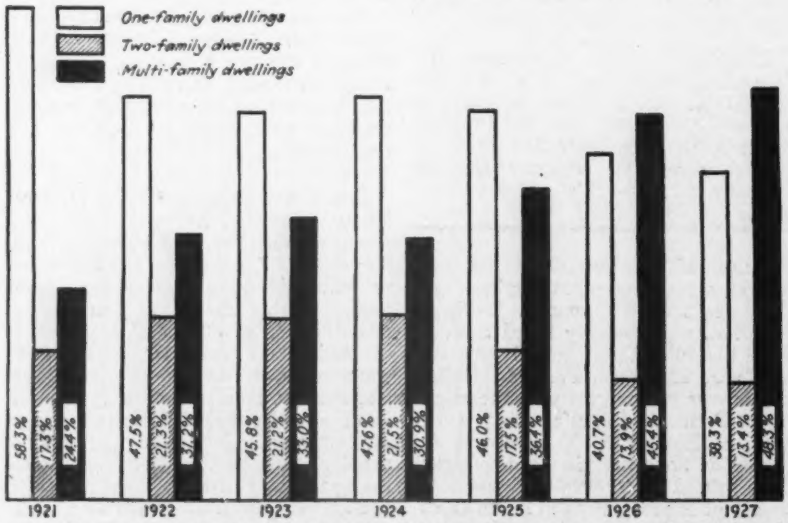
The National Industrial Conference Board in studying these basic data finds that the factors which make for the increase of the multi-family house appear to be in part the size of cities and in part their location. The basic data show that the proportion of families provided for in multi-family houses is greater in the large cities than in the smaller ones, but that among the latter there are a considerable number, adjacent to metropolitan cities, and particularly New York, in which the proportion for multi-family houses is very large.

In 1921 only a little more than one-third of the families provided for in the four largest cities of the country—New York, Chicago, Philadelphia and Detroit—found accommodations in one-family houses, in cities from 500,000 to 1,000,000 population almost 60 per cent and in the smaller cities 70 per cent. Conversely the multi-family house provided for more than four-tenths of the families in the four largest cities but less than one-fifth elsewhere. In 1927, however, only six years later, an entirely different picture of housing conditions is presented. The one-family dwelling in the four larger cities and in the New York metropolitan area is fading from the picture. Though losing ground, it still dominates in Philadelphia building operations, and in Detroit such such one-family dwellings house more than one-third of the families provided for in 1927 building operations. The two-family house gained in Detroit, made an appearance in Philadelphia and lost ground in the two larger cities. In Chicago more than three-fourths and in New York nearly three-quarters of the families provided for in new dwellings were accommodated in multi-family dwellings, and even in conservative Philadelphia multi-family houses provided one-fourth of the new dwelling accommodations. In 1927 any marked difference between New York City and the cities of the metropolitan area had disappeared.

The Conference Board reaches the conclusion that radical changes are taking place in American city houses. They are becoming more and more temporary lodge quarters, less and less permanent establishments. A few years ago such changes would have given food for thought, not to say apprehension for the future. The modern generation has witnessed so much change, so much adjustment to new conditions, that it has largely lost the fear of change.

### E. N.-R. Index Numbers

| | Cost | | Volume | | |
|---|---|---|---|---|---|
| **Oct. 1,** | **1928** | **207.71** | **September,** | **1928** | **296** |
| Sept. 1, | 1928 | 207.29 | August, | 1928 | 306 |
| Oct. 1, | 1927 | 204.40 | September, | 1927 | 273 |
| Average, | 1927 | 206.24 | Average, | 1927 | 263 |
| Average, | 1926 | 208.03 | Average, | 1926 | 228 |
| 1913 | | 100.00 | 1913 | | 100 |




BUILDING OPERATIONS IN 257 AMERICAN CITIES SHOW A TREND AWAY FROM THE OLD-FASHIONED HOME

## Factors in Sustained Business Activity

All authorities agree that the general business situation has been and still is featured by a widespread feeling of optimism. The Standard Statistics Company of New York finds from its studies that in any period of sustained business and industrial activity, such as that prevalent at the present time, the basic factors are psychological as much as anything else and are the result of a quite often unexplainable feeling of optimism in the business community. Such an undercurrent of optimism has prevailed during the current fall.

Standard Statistics finds that among the reasons for the optimistic feeling that has been rather generally prevalent in recent months may be listed:

1. The dissipation of earlier fears concerning the possible unsettling effect of the election.

2. The feeling in some quarters that banking sentiment had leaned too far on the conservative side and that the strength of the stock market, in the face of attempts to curb its activity, was not entirely unjustified.

3. The availability of business credits at but slightly greater cost than a year ago.

4. Excellent crop results and, in the main, reasonably good farm product prices.

5. The large-scale consumer demand in most lines that inevitably materializes when there is any reasonable basis for hope of continuing large purchasing power.

## Contracts Awarded 29 Per Cent Over Last Year

The week ended Oct. 23 witnessed a volume of contracts awarded of near record proportions for the year, being exceeded only by two of the early weeks of the year. The total of $100,382,000 was 12.3 per cent over the week previous, and 29.3 per cent over the same week last year. The accumulated total for the year is 16.4 per cent over the same period of 1927. The week's awards for industrial buildings were slightly under last year, but the total for commercial buildings of $59,576,000 was the largest during any week this year with but one exception.

### This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended Oct. 23, with some comparisons, total as follows:

(In Thousands of Dollars, 000 Omitted)

| | Oct. 23, 1928 | Oct. 16, 1928 | Oct. 25, 1927 |
|---|---|---|---|
| Buildings: | | | |
| Industrial | $20,318 | $17,390 | $21,641 |
| Commercial | 59,576 | 35,639 | 36,085 |
| Streets and roads | 10,720 | 7,491 | 13,494 |
| Other construction | 9,768 | 28,852 | 6,352 |
| Total | $100,382 | $89,372 | $77,572 |
| Total, all classes, Jan. 1 to Oct. 23: | | | |
| 1928 | | | $3,045,652 |
| 1927 | | | 2,618,600 |